PB-245 674

A TECHNICAL, ENVIRONMENTAL AND ECONOMIC EVALUATION OF THE WET PROCESSING SYSTEM FOR THE RECOVERY AND DISPOSAL OF MUNICIPAL SOLID WASTE

Systems Technology Corporation

Prepared for:

Environmental Protection Agency

1975

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National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

PB245674

BIBLIOGRAPHIC DATA SHEET

1. Report No. EPA/ 530/SW-109c

2.

3. Recipient's Accession No.

4. Title and Subtitle
A Technical, Environmental and Economic Evaluation of the "Wet Processing System for the Recovery and Disposal of Municipal Solid Waste"

5. Report Date

6.

7. Author(s)
Systems Technology Corporation

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Systems Technology Corporation
3131 Encrete Lane
Dayton, Ohio

10. Project/Task/Work Unit No.

11. Contract/Grant No.
68-01-2211

12. Sponsoring Organization Name and Address
U.S. Environmental Protection Agency
Office of Solid Waste Management Programs (AW-463)
Washington, D. C. 20460

13. Type of Report & Period Covered
Final

14.

15. Supplementary Notes

16. Abstracts

A technical, economic, and environmental evaluation of a wet pulping process used for the recovery and disposal of municipal solid waste. The process was designed by the Black Clawson Company and has been funded by the Environmental Protection Agency for demonstration in Franklin, Ohio. The demonstration facility consists of three major systems: hydrasposal, fibre recovery, and glass and aluminum recovery. This report presents the data for the hydrasposal and fibre recovery systems only.

17. Key Words and Document Analysis. 17a. Descriptors
Municipal solid waste, recycling, EPA demonstration grant Franklin, Ohio

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

PRICES SUBJECT TO CHANGE

18. Availability Statement

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 223

22. Price 7.25-2.25

296172
PB 245 674

A TECHNICAL, ENVIRONMENTAL AND ECONOMIC EVALUATION OF THE "WET PROCESSING SYSTEM FOR THE RECOVERY AND DISPOSAL OF MUNICIPAL SOLID WASTE"

This final report (SW-109c) describes work performed for the Federal solid waste management programs under contract No. 68-01-2211

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An environmental protection publication (SW-109c) in the solid waste management series.

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ACKNOWLEDGEMENTS

This document presents the results of a study performed for the U.S. Environmental Protection Agency, Office of Solid Waste Management, by Systems Technology Corporation. Mr. Dave Arella was the initial technical monitor for the EPA. Mrs. Yvonne Garbe and Mr. Fred Smith assumed technical direction upon the departure of Mr. Arella. Mr. Melvin C. Eifert was the Project Engineer for Systems Technology Corporation.

The performance of this study required the cooperation of many individuals. Without the help and interest of these contributors, it would have been impossible to gather the data reported herein. The authors wish to acknowledge the contributions of Mr. Dave Arella, Mrs. Yvonne Garbe and Mr. Fred Smith of the U.S.EPA; Messrs. Howard Creelman, Paul Marsh and Earl Blakely of Black-Clawson, Fibreclaim Incorporated; and Mr. Bernard Eichholtz of the City of Franklin, Ohio. The authors further acknowledge the contributions of Messrs. Wilbur Brooks, Anwar A. Ghazee, and Michael J. Hoegler of Systems Technology Corporation.

1.0 SUMMARY OF EVALUATION

1.1 INTRODUCTION

This report presents the results of a study to perform a technical, economic, and environmental evaluation of the wet processing concept for the disposal of solid waste. The facility of interest is the Franklin Solid Waste and Fiber Recovery Plant, located in Franklin, Ohio. The data derived and presented in this report is intended to be used by engineers and administrators involved in problems of solid waste disposal.

The facility as designed consists of three major systems; Hydrasposal (containing the pulping, separation, dewatering and incineration subsystems); Fiber Recovery; and Glass Recovery. This report presents the data for the Hydrasposal and Fiber Recovery systems only. A subsequent report will present the Glass Recovery Evaluation.

1.2 PLANT PERFORMANCE

The Franklin Solid Waste and Fiber Recovery Plant has been operational since May 1971, processing an average of 35 tons per day at a throughput rate of approximately 7 tons per hour. During this time, the plant has never turned away material from the tipping floor due to overload or equipment failure.

The plant recovers magnetic materials, paper fiber, and glass. It is capable of recovering 94% of the incoming magnetic fraction, and 48.9% of the input paper fraction.

With all systems except the glass plant operating, the plant consumes 157 Kwh of power per ton of input refuse. Of this, 21% is consumed by the hydrapulper, 71% by the remaining portion of the separation, dewatering, and incineration system, and 8% by the fiber recovery system.

When fiber recovery is not used, the facility can operate in a closed loop mode which is water deficient (i.e., it requires additional water for pulping and does not discharge water that would require treatment by a wastewater treatment plant).

With fiber recovery operational, the plant requires 3060 gallons of water/ton of input refuse for its operation. The plant in turn sends 2500 gallons of whitewater/ton of input refuse for treatment to the adjacent wastewater treatment plant. At Franklin, 2300 gallons/ton of the required water comes from the final clarified water of the adjacent wastewater treatment plant. 760 gallons/ton of city water is also used for the operation of the plant.

Without the glass plant, approximately 20.4% of the refuse stream by weight, requires landfilling. The landfill material includes the feed to the glass plant, the non-magnetic fraction, and oversized rejects pulled from the solid waste input on the tipping floor. With the glass plant operating, 15% by weight, requires landfilling. The following paragraphs will present more information about the technical, environmental, and economic evaluations for each of the major systems within the plant.

1.3 TECHNICAL EVALUATION

1.3.1 Pulping and Separation (P&S) Subsystem

The approximate composition of the raw solid waste at the Franklin Plant follows:

Inerts	3.4%
Non-Fiber Organics	37.0%
Glass	8.5%
Magnetic Metals	9.8%
Non-Magnetic Metals	1.3%
Paper	40.2%

An initial 7.5% (by weight) of the raw solid waste is removed from the tipping floor as unprocessable materials.

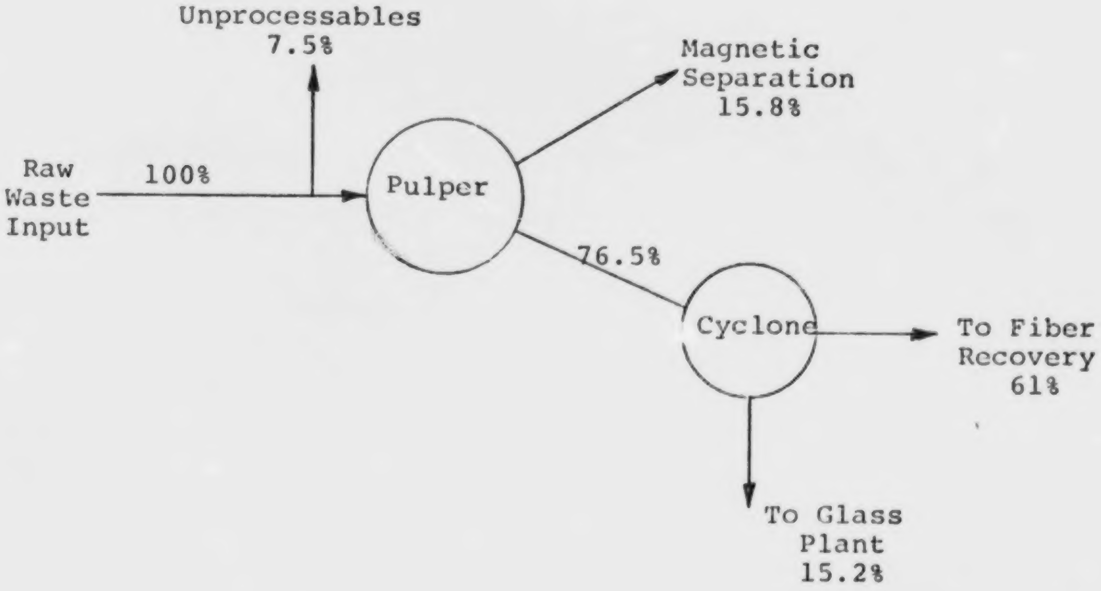
In the first step of the pulping and separation subsystem the solid waste is sent to the hydrapulper where it is pulped and divided into a light and heavy stream. The light fraction leaving the pulper reflects approximately 76.5% (by weight) of the input refuse. The heavy fraction removed from the hydrapulper, is approximately 15.8% by weight, and passes by a magnetic belt which removes the magnetic material from the non-magnetic material.

The light fraction from the hydrapulper goes to a liquid cyclone where it is divided into another light fraction and a heavy fraction. The heavy fraction is the feed to the glass plant and has a glass content of approximately 55%. The feed to the glass plant has a size distribution as follows:

> 3/4"	9.8%
< 1/4"	30.0%
1/4" ≤ 3/4"	60.0%

The size distribution changes significantly depending upon the condition of the pulper hammers between replacement.

The light fraction from the cyclone is fed to the fiber recovery system. Average fiber content in this stream is approximately 44%. This stream has a solids content between 1.5 and 4.1% and has an average heating value of 7700 BTU/lb on a dry weight basis. The fractional break-out of the input refuse from the pulping and separation system is as follows:



More detailed technical information about the pulping and separation subsystem can be found in Section 5.2.

1.3.2 Dewatering and Incineration (D&I) Subsystem

The D & I subsystem receives, dewaters, and incinerates the unusable portion (reject) from the fiber recovery system, or the entire process stream from the P & S subsystem. With fiber recovery operating, the rejects from fiber recovery, unrecovered residuals, are stored for dewatering and incineration. If fiber recovery is not used, the stream from the cyclone is stored for dewatering and incineration.

Dewatering is accomplished by a two stage process. The first state is a barrel thickener which reduces the moisture content to 80 - 82%, and the second step is a cone press which reduces the moisture content to 53 - 55%. Wastewater treatment sludge is introduced into the stream prior to the cone press dewatering step. The material is then pneumatically conveyed to the reactor. The material has a heat value of 8600 BTU/lb on a dry weight basis and 3600 BTU/lb on an as-received basis.

1.3.3 Fiber Recovery System

The fiber recovery system receives the light fraction from the cyclone in the pulping and separation subsystem and recovers a portion of the usable fiber contained in it. This recovered fiber is used by an adjacent manufacturer as a substitute for other paper sources in the manufacturing of roofing felt.

The first step of the fiber recovery process screens all particles greater than 1/16" from the stream. The second step pumps the fiber stream through centrifugal cleaners where grit particles are removed. The third step directs the fiber stream to a run-down screen which removes small fibers and water from the stream. The rejects from the first screening operation and the centrifugal cleaners are stored prior to dewatering and incineration.

The slurry containing the washed and recovered fiber has a solids consistency of approximately 2.2%. Approximately 48% of the fiber in the incoming waste is recovered. The recovered fiber is then dewatered through a barrel thickener and cone press similar to that used in the dewatering and incineration subsystem where the material moisture content can be reduced from 97% to 55%. The recovered fiber has a heat content of approximately 7200 BTU/lb on a dry weight basis, an oil and grease count of 2460 mg/l, and a bacterial count as follows:

Total Plate Count	427×10^6/ml
Fecal Coliform	1.3×10^6/100ml

The average power consumed by the fiber recovery system is 21.9 Kwh/ ton of input to fiber recovery. The amount of process water used per ton of material to the fiber recovery system averages 1600 gallons.

1.4 ENVIRONMENTAL EVALUATION

1.4.1 Environmental Impact on Air Quality

The effect on air quality of the Franklin Solid Waste and Fiber Recovery Plant can be determined by evaluating the emissions from the fluidized bed incinerator. Based on test data performed by an independent lab in January, 1972, the exhaust gases from the venturi scrubber contain a particulate loading of 6.11 lb/hour (a grain loading of .019 G/SDCF), SO_2 of less than 7 ppm, a NO_x level of 125 ppm and a moisture content of 34%. These emissions comply with current Ohio Air Pollution control regulations. Section 6.2 of this report presents more detailed information about the environmental impact on air quality.

1.4.2 Environmental Impact on Water Quality

The impact on water quality was assessed by evaluating the influent and effluent flows from the solid waste plant. At Franklin, liquid inputs to the solid waste plant consist of process water obtained from the chlorinated final effluent from the adjacent wastewater treatment plant, and city water obtained from the municipal water supply of the City of Franklin. A third input is the moisture contained in the input refuse and sewage sludge.

There are three liquid outputs from the solid waste plant which flow to the adjacent sewage treatment plant; (1) liquid extracted by the dewatering and incineration subsystem; (2) ash slurry from the venturi scrubber; and (3) liquids removed in the fiber recovery system.

The output from the venturi scrubber (ash water) does not require biological treatment and only requires solids removal. The combined flows from the D & I subsystem is approximately 4400 gal/ton input. The BOD_5 loading is approximately 100 pounds BOD_5/ton, which represents a population equivalent of 600 people/ton. The combined suspended solid loading averages 160 pounds of suspended solids/ton. The effluent from fiber recovery contributes 81% of the suspended solids loading and 73% of the BOD_5 loading of the effluents leaving the plant.

The plant has operated under a closed loop condition (without fiber recovery). Under this test condition, 62 gallons of water per ton of refuse processed is consumed. The conclusion drawn from this test was that the plant can be operated on a closed loop basis without external connection to a wastewater treatment plant. More detailed information on the environmental impact on water quality can be found in section 6.4.

1.4.3 Environmental Impact on Land

One of the original objectives of the Franklin Solid Waste and Fiber Recovery Plant was to reduce the quantity of material to be landfilled. If it is assumed that the tipping floor unprocessable material, the non-magnetic junk, and the glass plant feed requires landfilling, a savings of 71% in landfill volume can be achieved with the operation of a

Franklin type plant. With the glass plant operational, a savings of 76% in landfill volume can be achieved.

1.4.4 Noise Pollution

In the current design, the hydrapulper generates noise levels up to 104 dBA. Personnel involved in the pulper operation are not required to be in the room during the operation of the equipment. Hence, these personnel are not exposed to noise levels exceeding OSHA standards. Alternate designs are available that would isolate the hydrapulper so that noise would be minimized. Noise levels outside the plant at 100 to 150 feet from the plant are in the range of 50 to 60 dBA.

1.4.5 Odor Analysis

During normal operation of the plant, a slight garbage odor is detectable outside near the tipping floor, and within the plant. However, this odor problem is minimal and at 100 to 150 feet from the facility, there is little or no detectable odor. When the plant is accepting sewage from the adjacent wastewater treatment plant, there is a slight increase of sewage smell within the plant.

1.4.6 Bacteriological Analysis

By the nature of the material being handled, there is a biological hazard present. In the wet media the hazard should be no worse than anything processed through a sewage plant. If fact, it would seem that the presents of airborne contaminants would be less in a wet media than it would be in any air classified system.

1.5 ECONOMIC EVALUATION

Economic data for all major subsystems within the plant were developed. This will enable the use of this information for interested parties who may want to consider the use of only some part of the Franklin plant. Because of the energy crisis, it is doubtful that any future plants based on wet processing would incorporate an incinerator for the disposal of the residuals. Rather these residuals would be used as fuel. Hence, providing the data by subsystem, the economic information will be of much greater value.

The base line economic data was developed for 35 ton/day (T/D) processing, which was the average operating tonnage during the period of the evaluation. Using these data, the economic data was projected to 150 T/D which was the design capacity for the Franklin plant. The economic data was further projected to 500 T/D and 1000 T/D plant sizes. The economic data further presents the effects of selling the rejects as a fuel rather than disposing of the material in the incinerator. The following two tables summarize the economic data presented in section 7.0

FACILITY COSTS	Franklin Projected To 150 T/D	Franklin Projected To 500 T/D	Franklin Projected To 1,000 T/D
Income			
Paper Fiber	$ 8.06/T	$ 8.06/T	$ 8.06/T
Magnetic Metals	$ 2.40/T	$ 2.40/T	$ 2.40/T
Sludge Disposal	$ 1.75/T	$ 1.75/T	$ 1.75/T
	$12.21/T	$12.21/T	$12.21/T
Operating Expenses	$15.22/T	$ 9.96/T	$ 9.32/T
Facility Expense (20 yr. depr.)	$ 9.34/T	$10.46/T	$ 9.73/T
NET COST	$12.35/T	$ 8.21/T	$ 6.84/T

Operational Economic Summary of Projected Franklin Type Facility*

FACILITY COSTS	Franklin Projected To 150 T/D	Franklin Projected To 500 T/D	Franklin Projected To 1,000 T/D
Income			
Magnetic Metals	$ 2.40/T	$ 2.40/T	$ 2.40/T
Sludge Disposal	$ 1.75/T	$ 1.75/T	$ 1.75/T
Fuel	$10.71/T	$10.71/T	$10.71/T
	$14.86/T	$14.86/T	$14.86/T
Operating Expenses	$11.28/T	$ 6.04/T	$ 5.50/T
Facility Expenses (20 Year Depr.)	$ 3.79/T	$ 5.43/T	$ 5.05/T
NET SAVINGS	($ 0.21/T)	$ 3.39/T	$ 4.13/T

Operational Economic Summary of Projected Franklin Plant with No Fiber Recovery and Using Rejects as a Fuel*

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*No tipping fee is included in the analysis. Hence, the net operating cost can be compared directly to existing disposal costs.

2.0 INTRODUCTION

2.1 OBJECTIVES OF STUDY

The objective of this study was to perform a "Technical, Economic, and Environmental Evaluation of the Wet Processing Concept for the Disposal of Solid Waste." The subject facility was the Franklin Solid Waste and Fiber Recovery Plant, located in Franklin, Ohio. The following sections describe the type of evaluations made in each of the major categories.

The evaluations were performed over a nine (9) month period, (January 1, 1974 to September 30, 1974). The evaluations described below were made for each of the major systems within the plant; i.e., weighing and receiving, pulping and separation, dewatering, fluid bed reactor, and fiber recovery.

2.1.1 Technical Evaluation

The technical evaluation included:

(1) a detailed operational description of the Franklin Plant
(2) power and water consumption of each major system
(3) stream characterizations
(4) material balances among the major systems
(5) equipment descriptions
(6) equipment theory of operation
(7) equipment operating efficiencies when determinable

The results of the technical evaluation are presented in section 5.0.

2.1.2 Environmental Evaluation

The environmental evaluation included an analysis of the potential pollution of the surrounding air, land, and water. It also included an evaluation of the noise levels generated in the plant and observations an odor and industrial hygiene. Results of the environmental evaluation are presented in section 6.0.

2.1.3 Economic Evaluation

The economic evaluation of the Franklin Solid Waste and Fiber Recovery Plant included an evaluation to determine the economic viability of the technologies being used at Franklin. The economic data developed present a measure of the economics that would be experienced if any or all of the system used at Franklin would be incorporated in a solid waste facility that would be constructed and operated in competition with other disposal concepts.

The data gathered presents an economic evaluation of the four (4) major systems of the plant.

1. Weighing and Receiving
2. Pulping, Separation and Dewatering
3. Fluid Bed Reactor
4. Fiber Recovery

The data is presented in non-dollar related terms so that it can be readily used by all interested parties who may be considering the use of wet processing as a solid waste disposal concept. The results of the economic evaluation are presented in section 7.0.

2.2 HISTORY AND BACKGROUND

2.2.1 Franklin Plant

The City of Franklin, Ohio, Solid Waste Disposal and Fiber Recovery Plant (Franklin Plant) was constructed to provide municipal refuse disposal facilities for the City of Franklin and nearby communities. The facility was constructed and operated as part of an Environmental Protection Agency demonstration project grants #2G06-EC-00194-02 and 3-G06-EC-00194-151 (formerly the Bureau of Solid Waste Management, U.S. Public Health Service,) (HEW) to evaluate a new system for wet processing solid municipal waste. The Franklin Plant began operation in May 1971.

The system was originally designed to reclaim ferrous metallics and fibrous material from the solid waste, and to provide for the ultimate disposal of the residual wastes that could not be reclaimed. Glass reclamation capability was added in a Glass Recovery System plant modification which became operational in late 1973.

The facility is owned by the City of Franklin; operated by the Black Clawson Fibreclaim Company who developed the Hydrasposal/Fiber Recovery Process; the engineering firm for original plant design was A. M. Kinney, Inc. of Cincinnati, Ohio; and the Glass Container Manufacturers Institute (GCMI) was responsible for the design of the Glass Recovery System.

The Franklin facility is located adjacent to a new regional wastewater treatment plant constructed by the Miami Conservancy District (MCD), Dayton, Ohio. This plant was constructed to treat wastewater from local municipalities and a number of local paper mills. Facility construction was completed and operation began during the summer of 1972.

The close proximity of these two facilities makes it possible for them to offer complementary service to each other. For example, the solid waste facility incinerates sludge from the wastewater treatment plant, whereas the latter treats wastewater from the solid waste plant. So, the Franklin site is unique for two reasons: It is the first plant to use wet processing for the recycling and disposal of solid waste; and because of the interrelationship between the Franklin Solid Waste plant and the regional MCD wastewater facilities.

2.2.2 Contract

The contract for this study was awarded in September, 1973. The initial effort (Phase I) was to devise the evaluation procêdures to be used to collect, analyze, and present the technical evaluation of the Solid Waste and Fiber Recovery Plant. This phase of the effort required four (4) months to complete and included a two week period for pilot testing the technical evaluation concepts.

The nine (9) month technical, economic, and environmental evaluation began on January 7, 1974 and ended September 30, 1974. During the beginning of the evaluation, the Glass Plant was operational for only a small part of the first month of the evaluation. In the following months the operation of the Glass Plant was periodic and eventually terminated. It became apparent in mid-year (1974) that the Glass Plant would not be fully operational for the remainder of the nine (9) month evaluation period. It was concluded that additional time would be required to evaluate the Glass Plant. The Glass Plant evaluation again commenced on November 5, 1974, when the Glass Plant resumed full operation.

The Glass Plant data will be presented in a separate final report.

2.3 PROCESS DESCRIPTION

2.3.1 Introduction

This study involved an environmental complex comprised of two treatment centers; 1) the Franklin Solid Waste and Fiber Recovery Plant (Franklin Plant,) and 2) the Miami Conservancy District's Regional Wastewater Treatment Plant (MCD). Coordination is utilized between the two centers for optimum operation, however, the descriptions which follow will detail the components and operation of the Franklin Plant - the subject of our evaluation.

2.3.2 Definition of Terms

To eliminate confusion arising in the following description of the Franklin Plant operation, a definition of terms used within this section is presented:

Franklin Plant - Plant refers to the entire Franklin Waste Treatment and Fiber Recovery Plant.

System - Refers to one of the three major divisions of the plant, i.e. *Hydrasposal System, *Fibreclaim System, Glass Recovery System.

Subsystem - Refers to a subdivision of a system i.e., the Hydrasposal System can be subdivided into the pulping and separation (P & S) subsystem and the dewatering and incineration (D & I) subsystem.

Process Stream - Refers to the exiting, continuing stream from one processing unit to the next.

Reject Stream - The stream exiting a processing unit which contains the removed material.

Unit-Operation - Refers to any single equipment item or combination of minor equipment items, i.e., Hydrapulper, Magnetic Separator, etc.

2.3.3 Plant Systems (See Figure 1)

The Franklin Plant is comprised of three major systems: Hydrasposal™, Fibreclaim™, and Glass Recovery systems. The Hydrasposal system is further subdivided into two subsystems; the pulping/separation (P & S) and dewatering/incineration (D & I).

The P & S subsystem is the receiving, pulping, and primary separation subsystem.

The D & I subsystem dewaters and incinerates selected streams.

The Fiber Recovery System receives its input from the liquid cyclone of the P & S subsystem and by selective screening and water elutriation recovers the fiber contained within the stream.

The Glass Recovery system will be described fully in a report to be submitted as an evaluation of the Glass Recovery system.

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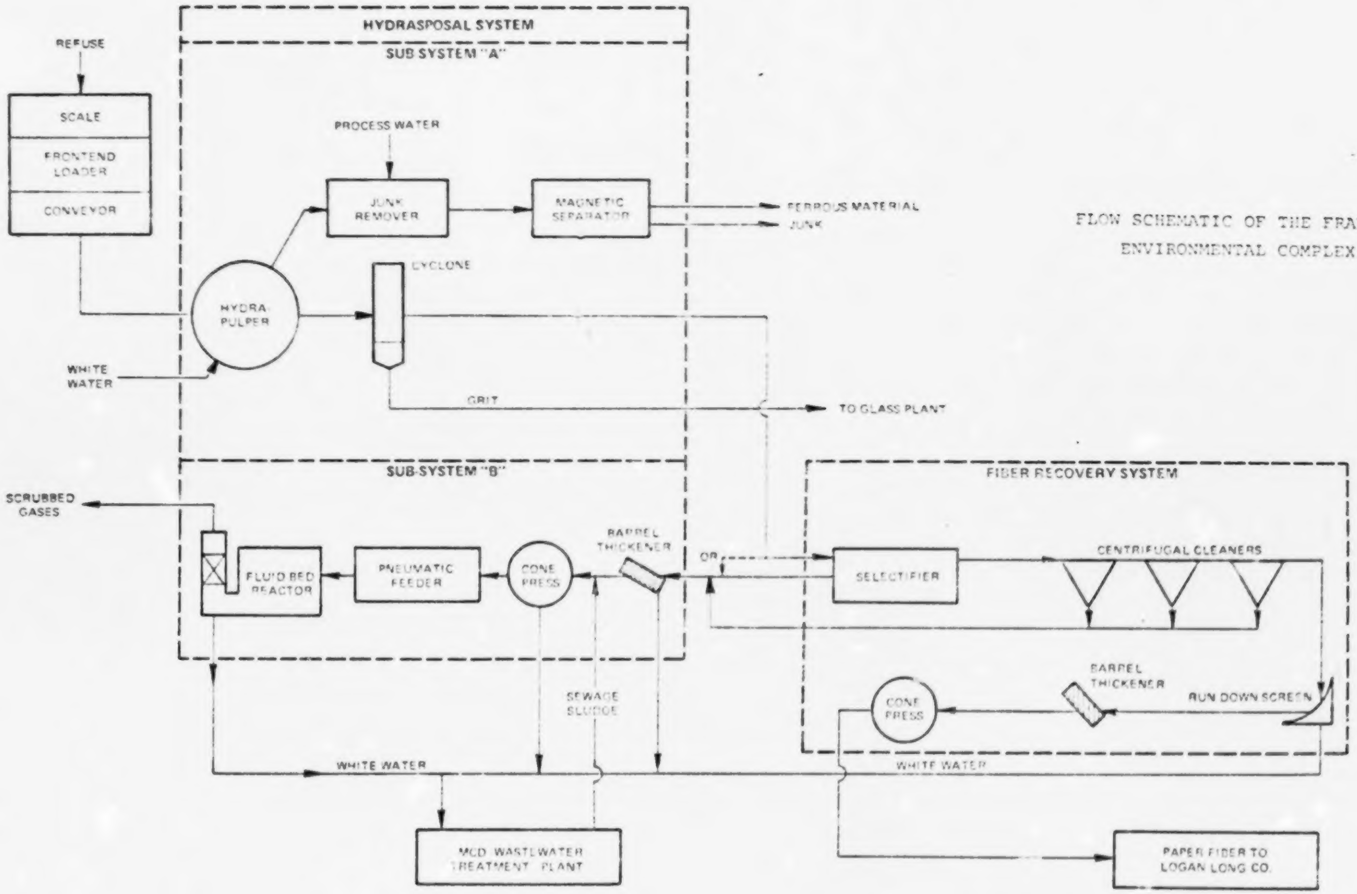
*Hydrasposal and Fibreclaim are copyrighted trademarks for the Black-Clawson Company, Middletown, Ohio, for systems for the disposal and separation of solid wastes, and the recovery of paper from the solid wastes respectively.


HYDRASPOSAL SYSTEM
SUB SYSTEM "A"
REFUSE
SCALE
FRONTEND LOADER
CONVEYOR
PROCESS WATER
JUNK REMOVER
MAGNETIC SEPARATOR
FERROUS MATERIAL
JUNK
CYCLONE
HYDRA-PULPER
WHITE WATER
GRIT
TO GLASS PLANT
SUB-SYSTEM "B"
SCRUBBED GASES
FLUID BED REACTOR
PNEUMATIC FEEDER
CONE PRESS
BARREL THICKENER
OR
SEWAGE SLUDGE
WHITE WATER
MCD WASTEWATER TREATMENT PLANT
FIBER RECOVERY SYSTEM
SELECTIFIER
CENTRIFUGAL CLEANERS
BARREL THICKENER
RUN DOWN SCREEN
CONE PRESS
WHITE WATER
PAPER FIBER TO LOGAN LONG CO.

FLOW SCHEMATIC OF THE FRANKLIN
ENVIRONMENTAL COMPLEX

FIGURE 1. FLOW SCHEMATIC OF THE FRANKLIN ENVIRONMENTAL COMPLEX.

3.0 OPERATIONAL CAPABILITY

3.1 INTRODUCTION

This section presents a detailed operational description of the systems and subsystems within The Franklin Plant. Figure 1 presents a flow schematic of the entire complex.

3.1.1 Pulping and Separation Subsystem Operation (See Figure 2).

Incoming solid waste is received from packer trucks and private haulers using personal vehicles. The packer trucks are weighed at the weigh station prior to (loaded weight) and after off-loading their refuse (tare weight). These vehicles are charged $7.50 per ton for refuse processing. The private vehicles are charged $2.25 per load.

After weighing, the solid waste is off-loaded onto the tipping floor, which is a shelter enclosed on three sides with an overhead sprinkling system and interior lighting. The solid waste in the tipping floor area is moved about by the use of a front-end loader (Bobcat). The operator of the front-end loader also works as the scale house operator.

The tipping floor operator picks out most large unprocessable materials, which may consist of refrigerators, tires, spring mattresses, tree trunks, spring steel, etc. These non-pulpable materials are placed into a large compactor adjacent to the tipping floor and are presently taken to a landfill. Large ferrous materials are placed in the ferrous metals bin. The solid waste is loaded onto the conveyor by the front-end loader.

The conveyor consists of an inclined, endless steel belt with ridges to prevent the solid waste from sliding down the conveyor. At the conveyor base is a sump for water drainage.

The conveyor feed rate is regulated by the hydrapulper motor loading. Presently, this is set at 300 amperes. When the motor load exceeds 300 amperes, the conveyor stops feeding the hydrapulper. When the motor load drops below 300 amperes, the conveyor again begins feeding the hydrapulper.

The refuse moving up the inclined conveyor falls into the hydrapulper where it is mixed with whitewater and macerated by the rotor located at the base of the hydrapulper. The rotation of the rotor generates an internal flow in the hydrapulper and blends the mixture. Smaller non-friable materials, (mostly cans and metals), are rejected by centrifugal force into the junk remover located near the base.

The junk remover is a continuous steel belt with small buckets which trap the non-friable materials. The junk remover conveys the material up and into a junk washer.

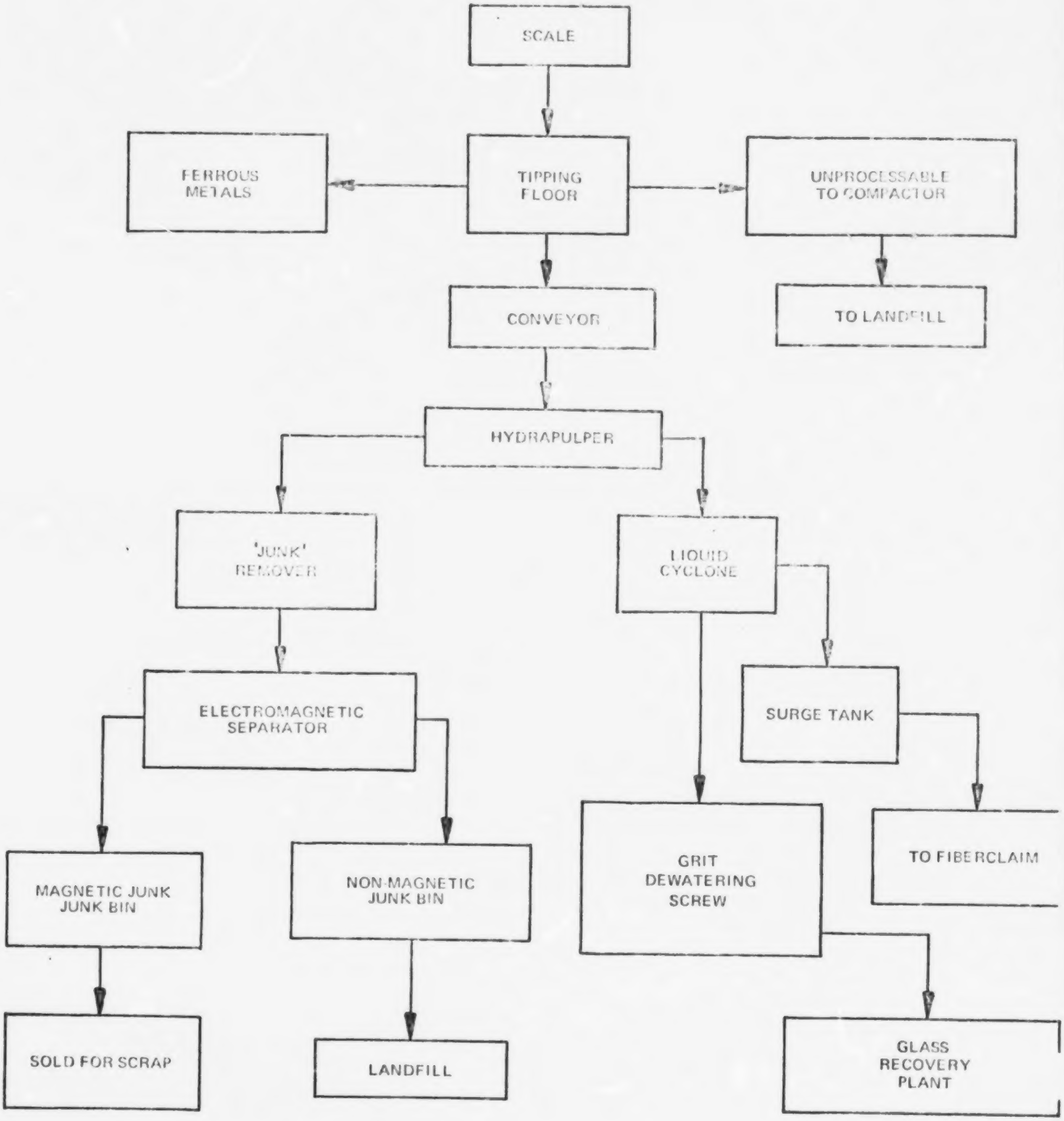

SCALE
FERROUS METALS
TIPPING FLOOR
UNPROCESSABLE TO COMPACTOR
CONVEYOR
TO LANDFILL
HYDRAPULPER
'JUNK' REMOVER
LIQUID CYCLONE
ELECTROMAGNETIC SEPARATOR
SURGE TANK
MAGNETIC JUNK JUNK BIN
NON-MAGNETIC JUNK BIN
GRIT DEWATERING SCREW
TO FIBERCLAIM
SOLD FOR SCRAP
LANDFILL
GLASS RECOVERY PLANT

FIGURE 2 - PULPING AND SEPARATION SUBSYSTEM

Originally the junk washer was used to clean the organic material from the metals in this stream. However, it was found that the washing was not necessary. The junk washer is now used as a conveyor which takes the rejects to a conveyor belt, which moves these non-friables to the continuous belted magnetic separator.

The magnetic separation takes place at the end of the separator conveyor. The magnetics are picked up onto the magnetic separator belt and dropped into the magnetics container. These magnetics are combined with the magnetics recovered from the glass plant and sold. The non-magnetics fall from the end of the separator conveyor into another container. These non-magnetics are either re-cycled to the hydrapulper or landfilled.

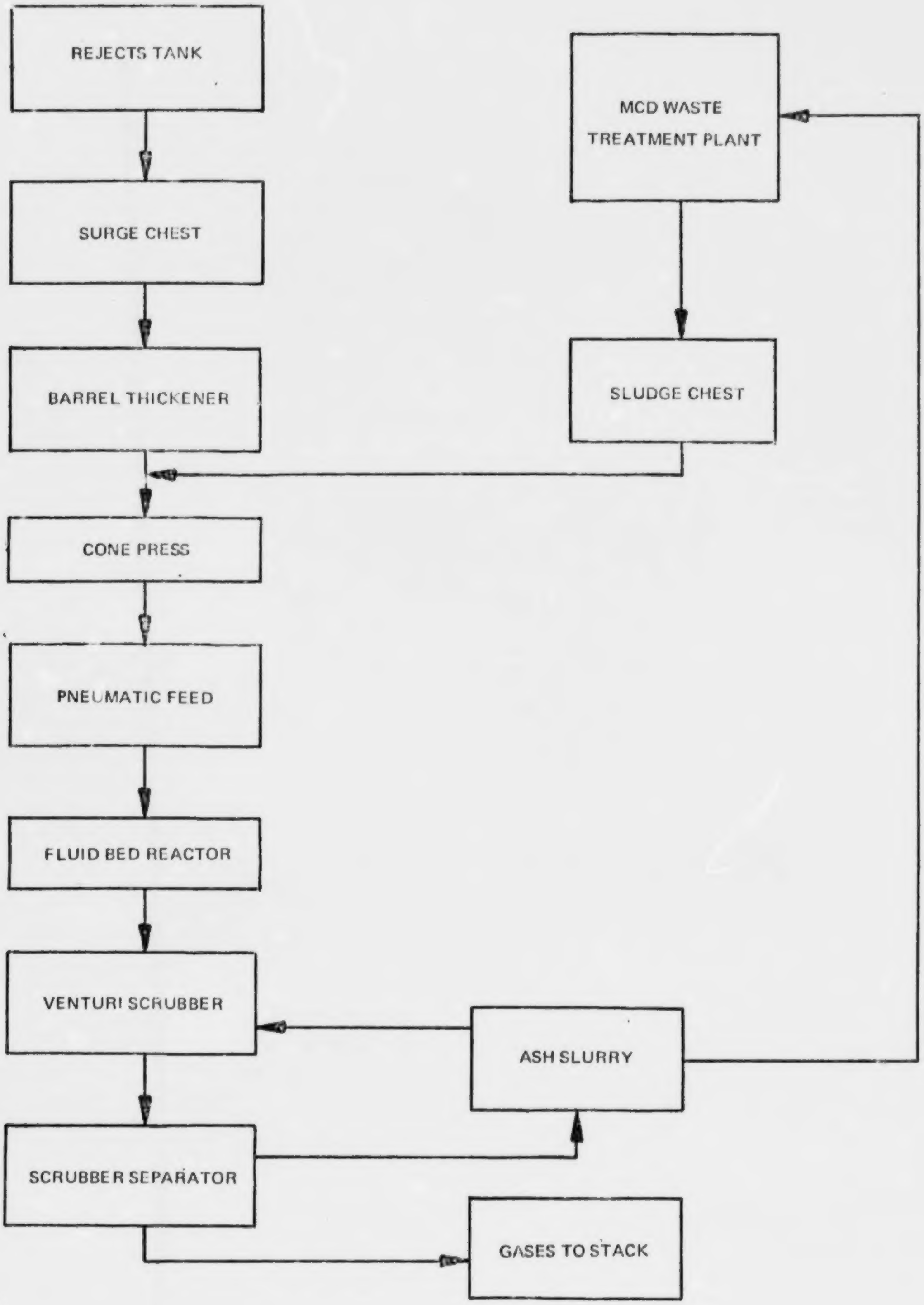
The liquid waste slurry generated in the hydrapulper is reduced in size by the rotor until it can pass through a perforated plate located beneath the rotor in the base of the hydrapulper. This plate consists of holes one inch in diameter. The liquid slurry which consists of fibers, glass, small pieces of metal, ceramics, and much of the white and red metal fraction is pumped from the hydrapulper by the dump pump into the liquid cyclone.

The liquid cyclone separates the heavier materials consisting of glass, small metal particles, organics, etc, from the lighter fractions. These heavy materials pass into a (grit) chamber at the bottom of the liquid cyclone after which they are dewatered and conveyed to the Glass Plant surge bin. The excess' water of this rejects stream is recycled to the hydrapulper. The lighter fraction from the liquid cyclone consists of light, fibrous materials, plastics, bits of aluminum foil, thread, grit,and small bones, etc. The cyclone process stream is then directed either to the fiber recovery system via the selectifier dilution tank or to the D & I subsystem.

3.1.2 Dewatering and Incineration Subsystem Operation (Figure 3)

Operation of the D & I subsystem is a singular mode; only the sources of the input change. The subsystem performs dewatering and subsequent incineration of materials obtained from three sources; (1) cyclone process stream of the P & S subsystem, (2) sludge from the Miami Conservancy District's Wastewater Treatment Plant (MCD), and (3) various streams as determined by operational mode (within the fiber recovery system).

The process streams described above enter a surge tank. This outdoor tank is equipped with a bottom agitator to prevent freezing and to keep the contents a uniform consistency. The surge tank contents are pumped to the barrel thickeners at 200 to 600 gpm.



REJECTS TANK
SURGE CHEST
BARREL THICKENER
CONE PRESS
PNEUMATIC FEED
FLUID BED REACTOR
VENTURI SCRUBBER
SCRUBBER SEPARATOR
MCD WASTE TREATMENT PLANT
SLUDGE CHEST
ASH SLURRY
GASES TO STACK

FIGURE 3 - DEWATERING AND INCINERATION SUBSYSTEM

The barrel thickener is a dewatering unit consisting of three square-pitch screws rotating within perforated cylinders. The dewatered material falls to a screw conveyor which transports the process stream to a Rietz Cone Press for further dewatering.

The cone press is a mechanical dewatering device consisting of a rotating wheel and a screen. The wheel rotates against the opposing screen, expressing water through the screen. Process water is used for cleaning the screen.

From the cone press, the process stream is then conveyed to the pneumatic feed via a rotary feed valve. There is no feed modulation at the pneumatic feed. The rate of feed is determined by the feed rate to the barrel thickeners and the amount of sludge added to the process stream. The process stream must contain approximately 30 percent solids to support autogenous combustion in the fluid bed reactor.

The Dorr-Oliver Fluid Bed Reactor has a rated capacity of 1.0×10^6 BTU/min. The bed diameter is 21 feet. The minimum calorific value of the fuel must be 3,000 BTU/lb. to operate autogenously. The bed temperature is maintained within a range of 1200-1400°F, with a maximum free-board temperature less than 1,800°F.

The combustion products are passed through a venturi scrubber for removal of particulate material. The efficiency of the venturi scrubber is very high with removal of 99 percent of the particulates, allowing the unit to meet all Ohio Federal Air Quality standards. The scrubber uses city water and operates with 7 inches of water pressure. The effluent from the venturi scrubber is pumped to the primary municipal clarifier at the MCD facility.

3.1.3 Fiber Recovery System (Fibreclaim) Operation (Figure 4)

3.1.3.1 Normal Mode of Operation - Normal operation of the fiber recovery system recovers fibers from the process stream by selective screening and elutriation of the pulped refuse. The input to the fiber recovery system is the process stream from the liquid cyclone in the P & S subsystem. This stream enters the fiber recovery system via the selectifier dilution tank.

In the selectifier dilution tank the cyclone process stream is diluted by addition of whitewater. This dilution is required for efficient stream separation in the selectifier screen. The selectifier screen is a high volume rotary-type pressure screen which rejects materials larger than 0.062 inches in diameter, and passes material less than 0.062 inches. The selectifier reject stream is directed to the rejects tank, and the process stream is directed to the cleaners supply tank.

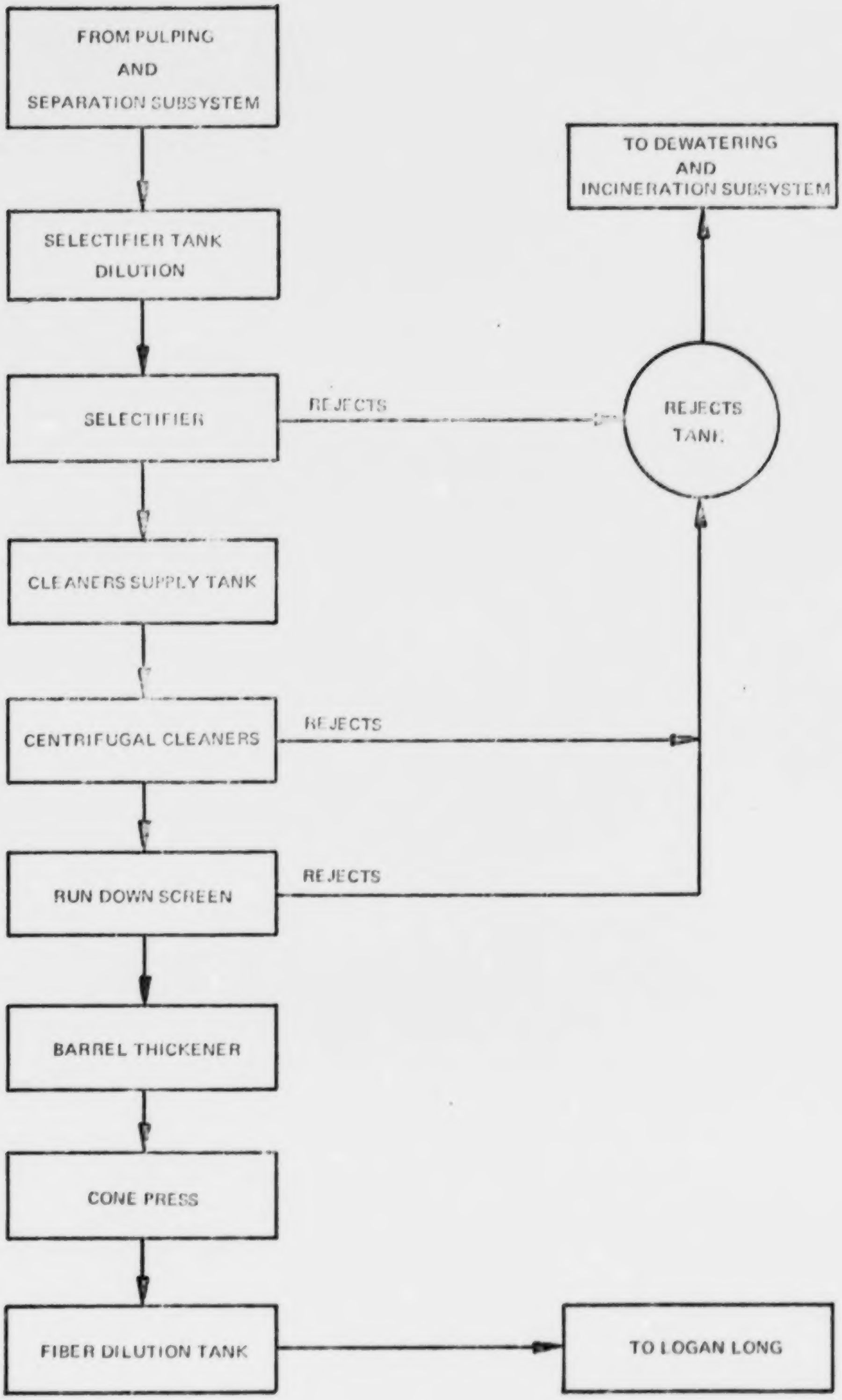

FROM PULPING
AND
SEPARATION SUBSYSTEM
SELECTIFIER TANK
DILUTION
SELECTIFIER
REJECTS
REJECTS
TANK
TO DEWATERING
AND
INCINERATION SUBSYSTEM
CLEANERS SUPPLY TANK
CENTRIFUGAL CLEANERS
REJECTS
RUN DOWN SCREEN
REJECTS
BARREL THICKENER
CONE PRESS
FIBER DILUTION TANK
TO LOGAN LONG

FIGURE 4 - FIBER RECOVERY SYSTEM - NORMAL MODE

From the cleaners supply tank the selectifier process stream enters the centrifugal cleaners for removal of grit, glass and other small, dense particles. Five centrifugal cleaners are currently used (16 available) and are plumbed for parallel operation to maintain optimum flow conditions necessary to achieve the desired removal efficiency. The centrifugal cleaners process stream is directed to the rundown screens, while the reject stream is directed to the selectifier rejects tank.

The rundown screens consist of four, 60 inch side hill screens with a feed flow capacity of 600 gpm. The screens are slotted, 0.020 inches wide, and are of non-clogging design. The process stream slurry from the centrifugal cleaners is received in an adjacent overflow well, and this slurry then flows down over the 0.020 inch slotted screens. As the slurry falls over the stationary screen, it is sprayed with process water. The rejects are extracted by falling through the screens into the whitewater sump while the screen process stream (recovered fiber) falls into the stock sump. The stock sump contents are then directed to the screw thickener during normal operation. The barrel thickener is similar to that in the dewatering and incineration subsystem. The thickener process stream is transported by a screw conveyor to the cone press and the rejects of both units are received in the whitewater system. The Rietz Cone Press (similar to D & I susbystem) further dewaters the recovered fiber. The process stream is directed to the fiber chest, and the rejects stream is directed to the whitewater sump. The dewatered fiber is rediluted and pumped via pipeline to the Logan Long plant for use in asphalt shingles and related products.

3.1.3.2 "Thickening" Mode of Operation

The fiber recovery system can also be operated in a "thickening" mode when fiber is not being recovered. As seen in Figure 5 the process stream by-passes the centrifugal cleaners, and mechanical thickeners. The selectifier reject stream and the rundown screen process stream are directed to the rejects tank, and then pumped to the surge chest in the D & I subsystem. This mode is utilized to increase the solids content of the cyclone process stream. The dewatering section of the D & I subsystem operates more effectively using this pre-thickened material.

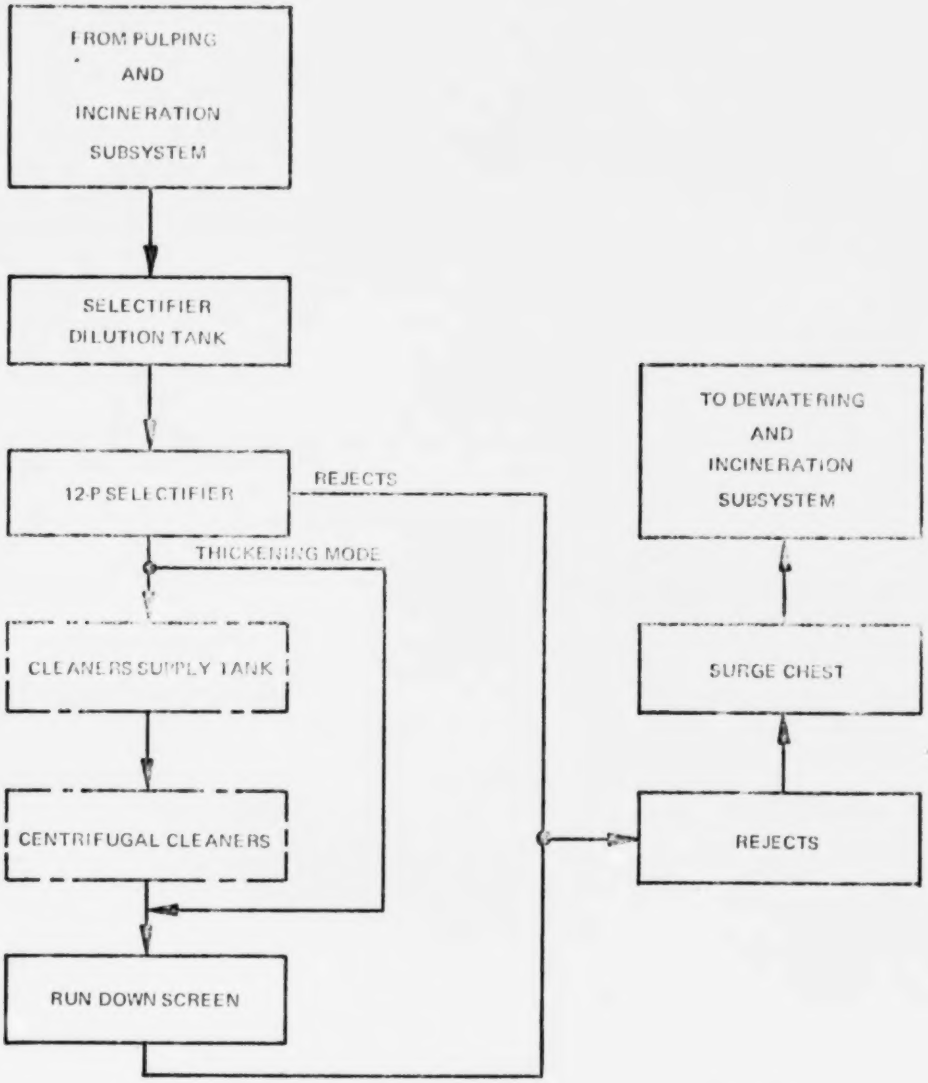

FROM PULPING AND INCINERATION SUBSYSTEM
SELECTIFIER DILUTION TANK
12-P SELECTIFIER
REJECTS
THICKENING MODE
CLEANERS SUPPLY TANK
CENTRIFUGAL CLEANERS
RUN DOWN SCREEN
TO DEWATERING AND INCINERATION SUBSYSTEM
SURGE CHEST
REJECTS

FIGURE 5 - FIBER RECOVERY SYSTEM - THICKENING MODE

4.0 EVALUATION METHODS USED

The paragraphs which follow describe the approaches developed for the data gathering and analysis used in the evaluation of the Franklin Solid Waste and Fiber Recovery System. The evaluations made in this study were numerous and extensive. This section presents the overall effort and discusses the methods that were used to accomplish the objectives of the study.

4.1 STUDY MATRIX DEVELOPMENT

To organize the principal areas of evaluation and to illustrate the scope of the study, a study matrix was developed and is presented in Figure 6. Along the horizontal coordinate, the plant is divided into the Hydrasposal and Fibreclaim systems. Each system is then divided into its unit processes.

The vertical coordinate is divided into three evaluation categories. Each category is then subdivided into its component parameters, thus, establishing a matrix relating each systems unit process and the proposed evaluation parameters.

However, all parameters to be considered in a major evaluation area may not be required for each unit process. To precisely define and illustrate the scope of this study, a mark is placed at the intersection of each process/parameter relationship that was evaluated for this effort. The matrix presented in Figure 6 represents the entire evaluation as performed.

4.2 SAMPLING METHODS

The previous sections of this report (Section 2.0) describe the evaluations that were to be made and the techniques to be used to obtain the required parameters for the evaluations. Obtaining this data required that many streams within the plant be sampled and analyzed. Process streams were sampled three to four times/day (depending upon total time plant was operated for that day) and composited for analysis. Sampling of the process streams other than the incoming refuse, was greatly simplified due to the use of numerous holding tanks throughout the plant. The use of these continously-mixed tanks as sample collection sites provided a more homogenous sample, representing a longer time period, than a sample of the incoming process stream.

During the initial phase of the effort, all streams that required sampling were identified. Some samples could not be obtained as simply as just described, and required that sampling valves be installed at several locations to draw the required samples. "Dipper" samples were used for sampling from the surge tanks, and valves on process lines were installed and used to draw samples where accessibility was limited.

EVALUATIONS ↓	PLANT SYSTEMS →	HYDRASPOSAL												FIBRECLAIM							
	UNIT PROCESSES / PARAMETERS	WEIGH IN	TIPPING FLOOR CONV.	HYDRAPULPER	JUNK REM. & WASH	MAG. SEP.	CYCLONES	THICKENER	CONE PRESS	TRANSPORT TO INC.	INCINERATOR	SCRUBBER	HYDRASPOSAL SYSTEM	SELECTIFIER	CENTRICLEAN	HYDRASIEVE	HYDRADENSER	CONE PRESS	FIBER TRANSPORT	FIBRECLAIM SYSTEM	TOTAL PLANT
TECHNICAL	DESCRIPTION OF EQUIPMENT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	THEORY OF OPERATION	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	DESIGN VS OPERATING EXP.	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	MAINTENANCE HISTORY	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	POWER REQUIREMENTS			○									○							○	○
	STREAM CHARACTERIZATION			○		○	○	○	○		○		○	○	○	○	○	○		○	○
	MATERIAL BALANCE			○		○	○	○	○		○		○	○	○	○	○	○		○	○
	EFFICIENCY			○		○	○						○	○	○					○	○
	RECOVERED PROD. CHARACT.					○							○					○		○	○
ECONOMIC	OPERATING LABOR COSTS	○	○	○	—	—	—	—	—	○	○	○	○							○	○
	OPERATING POWER COSTS	○	○	○	—	—	—	—	—	○	○	○	○							○	○
	MAINTEN. LABOR COSTS	○	○	○	—	—	—	—	—	○	○	○	○							○	○
	MAINTEN. PARTS COSTS	○	○	○	—	—	—	—	—	○	○	○	○							○	○
	GENERAL CONSTR. COSTS	○	○	○	—	—	—	—	—	○	○	○	○							○	○
	REVENUES	○	○	○	—	—	—	—	—	○	○	○	○							○	○
	OTHER DISPOSAL METHOD	○	○	○	—	—	—	—	—	○	○	○	○							○	○
	LAND DISPOSAL	○	○	○	—	—	—	—	—	○	○	○	○							○	○
ENVIRONMENTAL	AIR										○	○	○							○	○
	WATER								○	○		○	○			○	○	○		○	○
	LAND	○				○	○				○	○	○							○	○
	IN-PLANT NOISE			○									○							○	○
	ODOR												○							○	○

Figure 6 - Study Matrix

One of the major efforts to be performed in the technical evaluation was a mass balance of the plant. This balance was performed on a daily basis and composited weekly and monthly. This mass balance required performing flow measurements of many streams within the plant. These process stream flow measurements were performed using a variety of measuring techniques. Existing flow meters were calibrated and utilized. Timers were installed on pumps, and the pumps were calibrated to determine flows. Other schemes to record flow rates were; measuring the changes in elevation of the tanks over a period of time, and bucket and stop watch techniques, etc. These approaches were used to provide the necessary flow measurements without the expense of installing sophisticated flow meters.

The analyses of the samples was performed by Systech personnel in available space at the adjacent Miami Conservancy Wastewater Treatment Plant Laboratory. Systech personnel were permanently located at this facility for the duration of the sampling period.

4.3 SYSTEMS CONCEPT AND NETWORK ANALYSIS

The Franklin Solid Waste and Fiber Recovery Plant was designed to process solid waste into several fractions for reclamation and/or disposal. Essentially, it is a complex of many systems, subsystems, and unit operations connected in series and parallel combinations. In this sense, the plant can best be analyzed by applying the "Systems Approach" and analyzing the input and output of each system, subsystem, and unit operation. This section will demonstrate the systems approach and network analysis used in the study of the Franklin plant.

The numerous unit processes within the plant required stream definition to eliminate confusion in their description and analysis. The following schematic illustrates the procedure used for generating these stream descriptions.

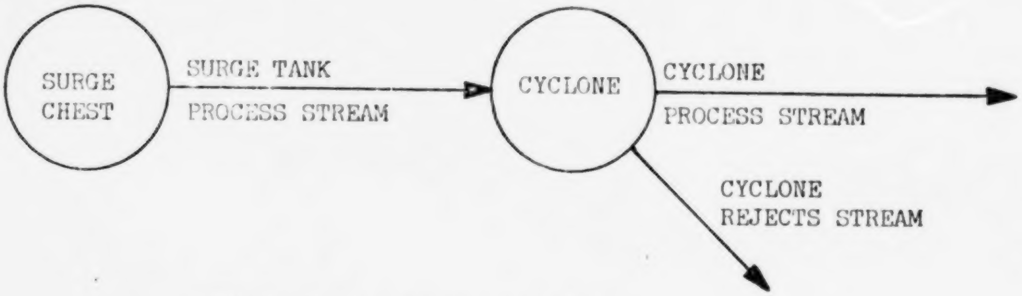


FIGURE 7 - SCHEMATIC DIAGRAM

As mentioned earlier the material passing through the unit operation is defined as a Process Stream while the material extracted by this unit operation is defined as a Reject Stream. This approach was used to develop the stream definitions which are presented in Appendix E.

As shown in Figure 1, the plant is represented schematically by a line diagram. This schematic is divided into two major systems by drawing a line around the unit operations contained within each system. This line is called the System Boundary and is also shown in Figure 9. The lines crossing the system boundary are the inputs and the outputs to the system. It is easy to see from this figure that any system, subsystem, or unit operation can be easily investigated by analyzing its inputs and outputs. In Figure 1 all of the inputs and outputs represent the material flow. A similar diagram could be prepared for showing cash flow, labor flow, etc.

For purposes of analysis, the diagram shown in Figure 1 can be further simplified into a network represented by branches and nodes. In this context;

- A branch is a portion of the system that connects any two unit operations,
- A node is a terminal of a branch and would represent a unit operation.

Applying the Network Concept, the pulping and separation subsystem is represented simply as follows:

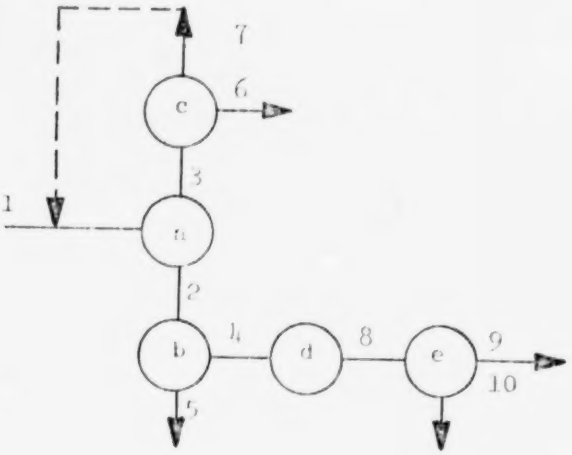


FIGURE 8 - NODE/BRANCH NETWORK

This network is greatly simplified and permits easy reference to branches and nodes. In this figure, nodes a, b, c, d, and e, represent the hydrapulper, liquid cyclone, the magnetic separator, surge tank, and the second liquid cyclone respectively. Branch 1 represents the incoming solid waste and water; branch 2 represents the pumped hydrapulper process stream; branch 3 represents the junk remover rejects stream; branch 6 represents the reclaimed ferrous material; and branches 5 and 10 represent cyclone reject streams that are sent to the glass reclamation plant.

Basically, there are two types of unit operations represented by nodes. They are "flow-through units", such as the liquid cyclones (b and e) and "storage units", such as surge tanks (d). It is significant to note that the plant is a relatively simple network and that almost all of the unit operations can be represented by three-branch nodes, with the exception of surge tanks which are two-branch nodes.

It is known that under steady-state conditions, the summations of the inputs and the outputs to a node can be equated to zero. In this context, the inputs are considered positive and the outputs are considered negative. For example, the mass flow rate (M) for node "b" in the example illustrated above is given by: $M_2 - (M_4 + M_5) = 0$

When steady state conditions do not exist, such as in the surge tank represented as node "d" in the illustration above, then the equation becomes: $M_4 = M_8 + M_d \times t$. Where M_d is the storage rate in the surge tank and t is time.

After reviewing the Franklin operation, it was determined that all flows approximate steady state conditions and that non-steady state conditions would not have to be considered.

Now, let us illustrate how this network analysis was of value to the study. Consider the problem of measuring tha amount of junk removed from the hydrapulper. Because of the process setup, it is not possible to directly measure the weight of this stream. However, by applying a mass balance to node "c" (magnetic separator) we know, (See Nodal diagram above)

$$m_{\text{Branch } 3} = m_{\text{Branch } 6} + m_{\text{Branch } 7}$$

and the weights of branches 6 and 7 can be measured. Thus, knowing this data, it is possible to compute the amount of junk removed.

Although this example is simple, the technique is applicable to more complex networks such as the entire plant, any of the three major systems, or some arbitrary system.

As another example, consider the problem of characterizing the incoming waste. The schematic below represents a portion of the hydrapulper system:

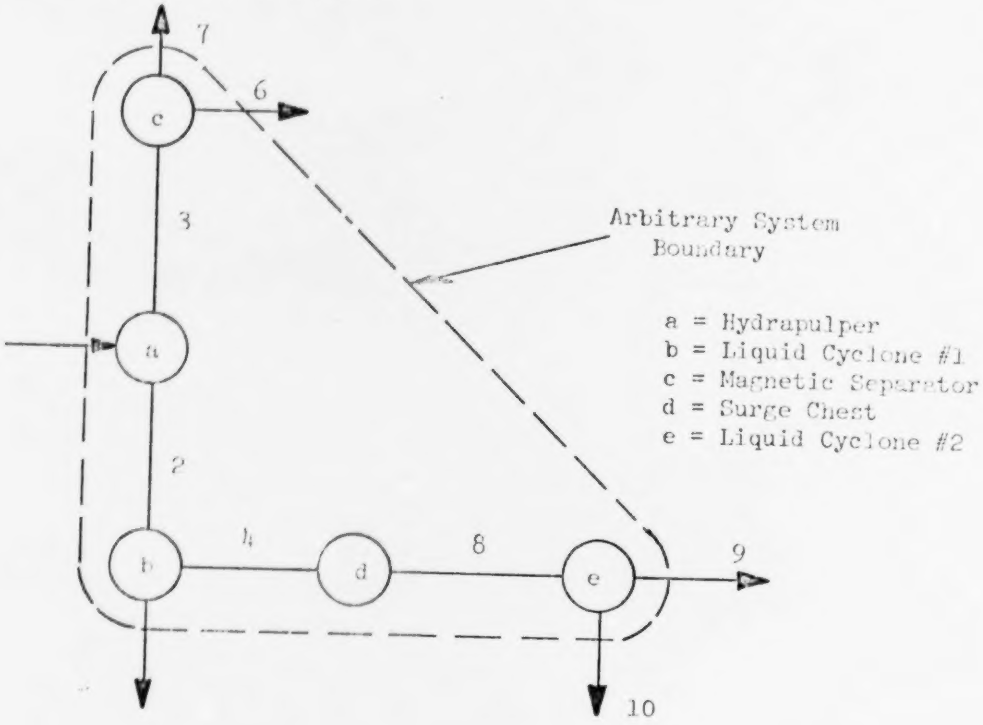

7
6
c
3
Arbitrary System Boundary
a
2
b
4
d
8
e
9
10
a = Hydrapulper
b = Liquid Cyclone #1
c = Magnetic Separator
d = Surge Chest
e = Liquid Cyclone #2

FIGURE 9 - P & S System Boundary

We know that data or samples can be gathered to characterize the material streams in branches 5, 10, 6, 7, and 9. Therefore, an arbitrary system boundary (which must be closed) is drawn through these branches and branch 1. In this arbitrary system, we can see that branch 1 is the only input. The others are all outputs. Thus, since the summation of the input must equal the summation of the outputs:

$$C_1 = C_5 + C_{10} + C_6 + C_7 + C_9$$

In this case C is used as a general parameter such as pounds, pounds per unit time, etc. In addition, the different fractions $C_5 + C_{10}$, C_6, C_7, and C_9 also represent different material classification such as ferrous metals, grit, slurry, etc.

The purpose of the above discussion was to demonstrate how Network Analysis was used to study the plant. The application of this technique facilitated a detailed and rigorous analysis.

It also provided a means of identifying the equipment and piping for data collection. Equipment and piping within the plant were assigned node letters or branch numbers for testing personnel.

5.0 RESULTS OF TECHNICAL EVALUATION

5.1 INTRODUCTION

The following paragraphs in this section of the report present the technical evaluation results of the study. The data represents a compilation of many months data. The equations derived and used to obtain some of the data are not presented in the body of the report. These equations, as well as copies of the data sheets used to gather the data, are presented in Appendix D to this report. Analysis of different streams, flow measurements, etc., are average operating data.

The items covered in the technical evaluation include;

- (1) mass balances of
  - (a) pulping and separation subsystem
  - (b) dewatering and incineration subsystem
  - (c) fiber recovery system
- (2) characteristics of individual streams within the plant
- (3) power and water usage data
- (4) material flow diagrams
- (5) descriptions of the physical appearance of individual process streams
- (6) comments on equipment effectiveness

To aid the clarity of this section, the raw material balance data, periodic test data, and data collection methods and sheets will be included in Appendix C of this report.

5.2 PULPING AND SEPARATION (P & S) SUBSYSTEM

The P & S subsystem pulps and separates the refuse into several streams which are suitable for further processing. This subsystem, in addition to reducing the particle size of the refuse, provides for fluid transport of the pulped refuse by addition of whitewater. The separation of the refuse into various fractions in the P & S subsystem can be illustrated by the following mass balance diagram (Figure 10).

5.2.1 Material Balance Sheet for P & S Subsystem

For this discussion, the P & S subsystem includes the tipping floor within its system boundary. Thus, the material which is unacceptable for processing is included on the balance sheet (Figure 10)

The inputs to the P & S subsystem consist of all the refuse delivered to the Franklin Solid Waste Plant and the water needed to process it. The whitewater is added to provide a

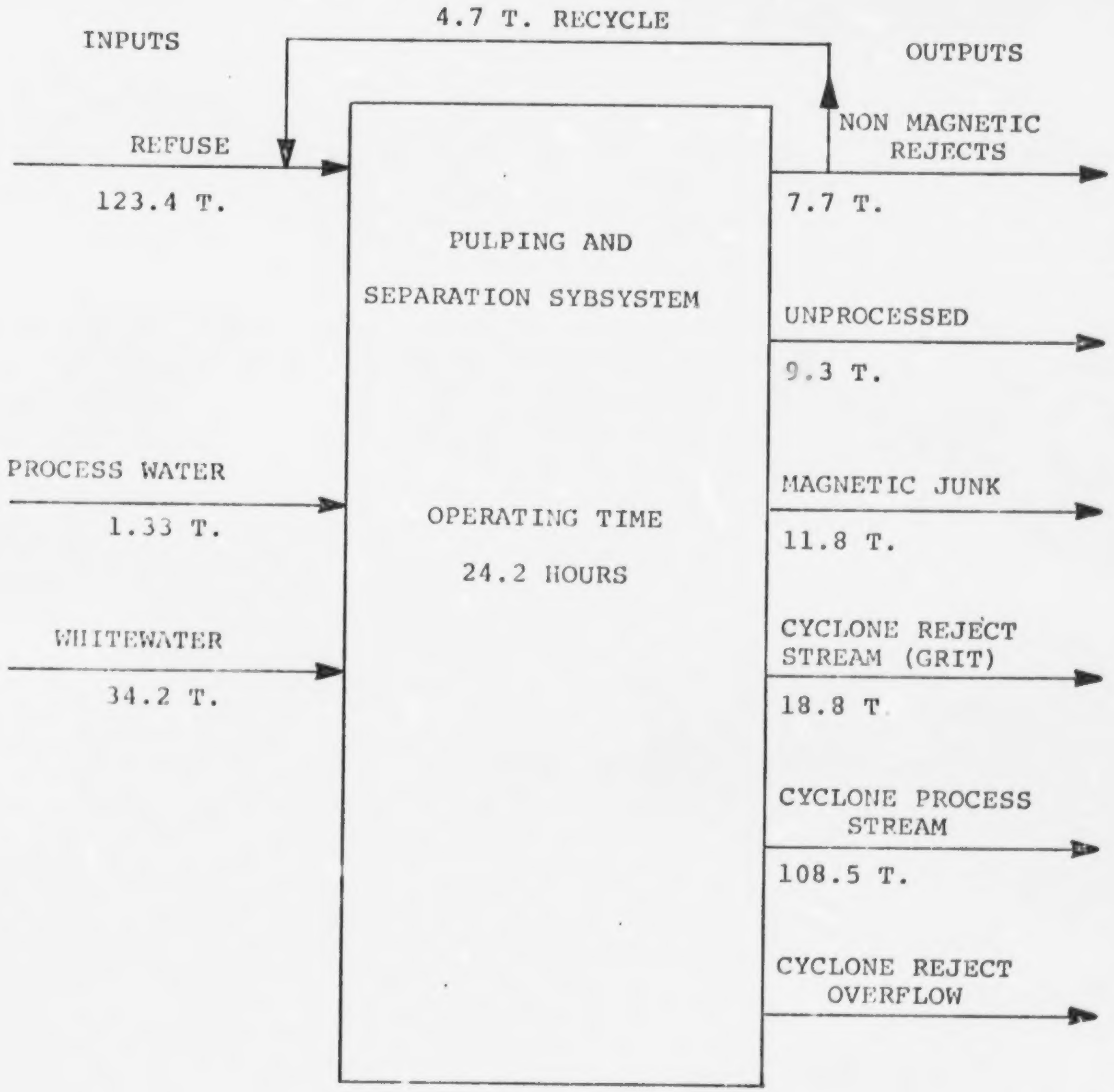

INPUTS
4.7 T. RECYCLE
OUTPUTS
REFUSE
123.4 T.
NON MAGNETIC
REJECTS
7.7 T.
PULPING AND
SEPARATION SYBSYSTEM
UNPROCESSED
9.3 T.
PROCESS WATER
1.33 T.
MAGNETIC JUNK
11.8 T.
OPERATING TIME
24.2 HOURS
WHITEWATER
34.2 T.
CYCLONE REJECT
STREAM (GRIT)
18.8 T
CYCLONE PROCESS
STREAM
108.5 T.
CYCLONE REJECT
OVERFLOW

Figure 10 - MATERIAL BALANCE SHEET**
PULPING & SEPARATION SUBSYSTEM

*All values are on a dry weight basis except as noted.

**Figure represents actual operating data for an average week.

media for pulping and transporting the refuse. The incoming refuse, averaging about 29.4 percent moisture, is pulped to an average consistency of 3.28 percent solids. The consistency of this stream can be varied by the operator by the addition of more or less whitewater. The actual operating range varies between 1.5 and 4.0 percent solids. The amount of whitewater used in the P & S averages 4,890 gal/ton of refuse input to the system.

The other liquid input to the P & S subsystem is process water (chlorinated final effluent from the wastewater treatment plant). The process water, which is relatively low in solids, is used as cooling water for the hydrapulper oil supply, and as elutriation water in the liquid cyclone. The quantity of process water used in the P&S subsystem varies from 990 to 2,700 gal/ton of refuse with an average usage of 1,630 gal/ton of input to the subsystem. The weights given for process water and whitewater in Figure 10, represent the actual weight of dry solids in the water added to the subsystem.

As indicated on the balance sheet, approximately 7-1/2 percent or 10.25 mt./wk. (9.3 tons/wk) is unprocessed material. This category includes materials such as refrigerators, stoves, large tree trunks, etc., which the hydrapulper cannot accept.

Tires can be processed, however, their retention time in the pulper is much longer than normal refuse. Because of tires and other unprocessable materials are removed by hand by the loader/scale house operator who watches for these materials. The remainder of the material is deposited on the apron conveyor and fed to the hydrapulper.

Non-pulpable material introduced to the hydrapulper is separated by centrifugal force and removed by the junk remover. These materials are further separated magnetically into magnetic and nonmagnetic junk, listed as outputs on Figure 10. These streams total 15.8 percent of the incoming refuse.

The nonmagnetic rejects have been recycled back to the head of the plant on an intermittent basis during the course of our study. However, it was felt that the recycle of this material should not be listed as an additional input to the subsystem because during normal operation, the non-magnetic rejects are landfilled. The recycling of this nonmagnetic material caused a gradual increase in the quanitty of nonmagnetic rejects being collected, which introduced a slight cumulative error in the study from a mass balance standpoint. It should be noted that the nonmagnetic rejects are gradually ground up by the pulper and removed by the cyclone.

The cyclone reject stream contains the gritty material removed from the pulped refuse slurry by the liquid cyclone. As an output of the P & S subsystem it represents 15.2 percent of the as-received refuse. This gritty material is the glass rich fraction of the refuse and is further processed in the glass plant.

The cyclone process stream is the largest output of the P & S subsystem, representing 87.9 percent (dry weight) of the incoming refuse. This output stream contains essentially all the paper, rags, sheet plastic, small pieces of wood, and food and garden wastes in the refuse. This stream averages 3.28 percent solids with a range of 1.5 to 4.09 percent solids. The consistency is regulated semiautomatically by the amperage used by the hydrapulper motor. The whitewater feed is constant and an increase in power used by the hydrapulper (>300 amperes) stops the refuse feed to it by stopping the conveyor. This conveyor is now operated by an on-off control, whereas in the past proportional speed control was used.

The cyclone rejects overflow is an output from the P & S subsystem to the whitewater system, and must be included to achieve a representative mass balance. The cyclone rejects overflow consists of whitewater, which is removed in the dewatering of the cyclone rejects. This whitewater, because of the overflow manifold arrangement, does not contain an appreciable amount of gritty material. This output from the P & S subsystem was computed by measuring the overflow from the manifold. This measurement was made several times during each operating day. Continuous measurement of this parameter was not possible and as a result this value is approximate.

5.2.2 Pulping and Separation Subsystem Stream Characteristics

The stream characteristics of the P & S subsystem were obtained from daily composite samples of process streams which were required to achieve the daily mass balances. Additional information was obtained from periodic tests which were performed on the individual streams within the entire plant. These data were used to develop characterizations of the input refuse.

The input refuse was also characterized by hand sorting. These hand sorts were performed at different times of the year to determine the seasonal variation in refuse composition. All characterization and mass balance data are included in Appendix C. Characterizations of the junk remover reject streams were performed on the magnetic and nonmagnetic rejects.

Both the cyclone reject and cyclone process streams cross subsystem boundaries. Therefore, they were characterized on the basis of being both an output to the P & S subsystem as well as the input to an adjacent system/subsystem.

The average characterization data are presented in Figure 11. This figure shows the characteristics of the input refuse as well as the streams in the separation phase of the P & S subsystem. The outputs represent both the outputs of the subsystems and the component parts of the input refuse. For example, the amount of clear glass in the cyclone rejects would for all practical purposes represent the clear glass component of the input refuse. Likewise, the fiber content of the cyclone process stream would contain essentially all the fiber in the input refuse.

The characteristics of the whitewater and process water used in the P & S subsystem are the same as the whitewater and process water characteristics used throughout the plant. The average characteristics of the whitewater and process water are given in section 5.2.3.6.

As is evident from the characterization data in Figure 11 the majority of fiber, plastic and other combustible products are contained in the cyclone process stream. Most of the glass is contained in the liquid cyclone rejects stream.

The figure also presents a flow schematic of the P & S subsystem. The arrows indicate the direction of flow. The characteristics of the streams at each individual processing point are shown. The percentage values located on the lines which connect unit processes indicate the percent of the input refuse which flows along this line. These percentage values are on a percent dry solids basis and do not indicate actual flow volumes.

The nongrindable magnetic and nonmagnetic materials are removed by the junk remover and separated magnetically. The recovered nongrindable-magnetic material (junk remover magnetic rejects) is the only recovered product obtained from the P & S subsystem. This recovered magnetic material is sold directly to a ferrous metal reprocessor without prior detinning or other processing (shredding).

The input refuse to the P & S subsystem has been characterized by 18 hand sorts performed at three different sorting periods during the year. The average sort data is given in Figure 13, and Table 1. This table is included to compare the composition of the solid waste at Franklin to solid waste streams in other parts of the country. As is evident from this table, the paper fraction of the solid

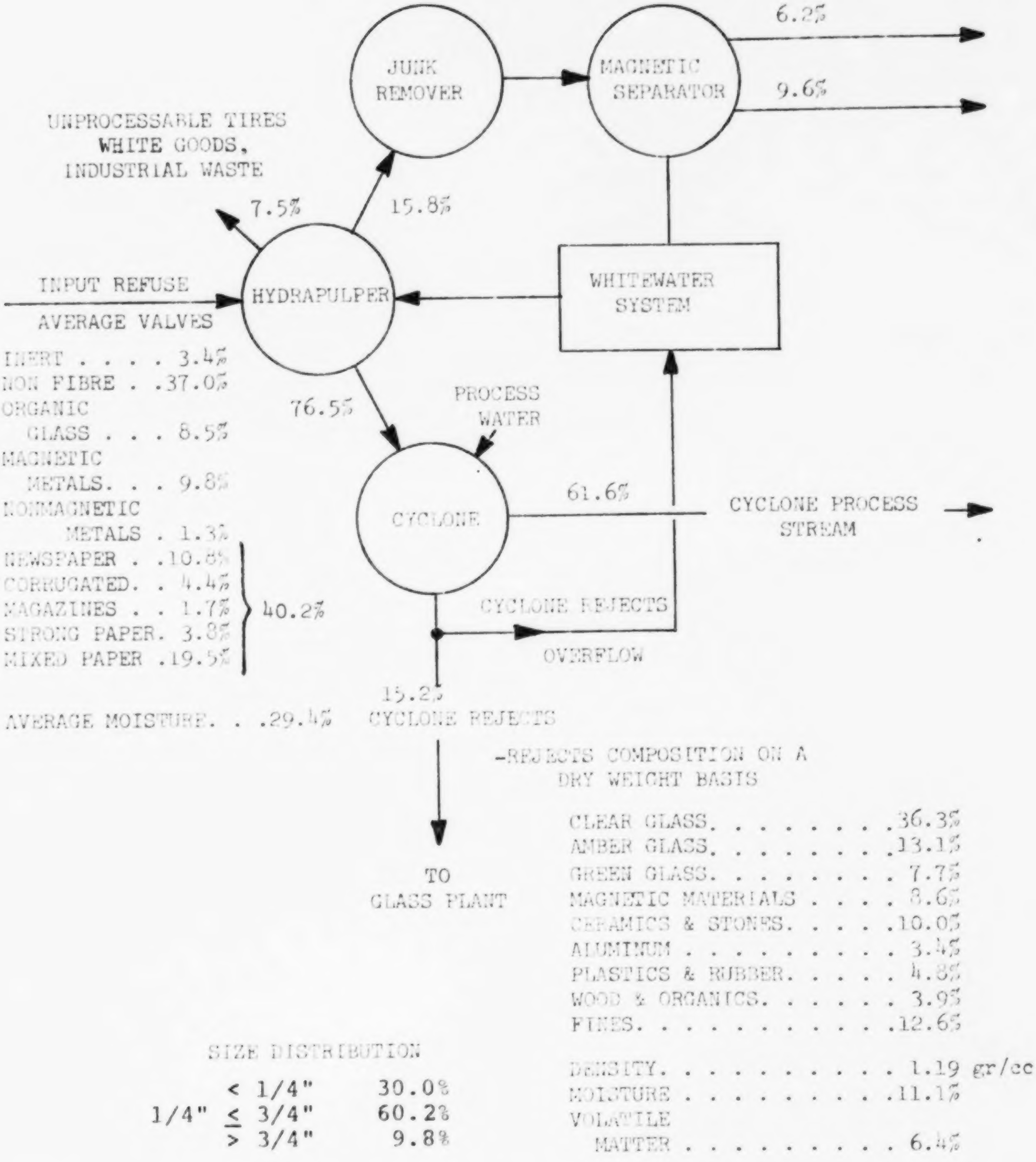
Table 1 - Refuse Composition Comparison Table

Category	Franklin Percent		Hempstead N,Y.* Percent		Johnson City** Percent		Nat. Avg.*** Percent	
Paper	40.1		42.52		45.5		37.8	
Newspaper		10.8		13.56		----		----
Corrugated		4.4		5.23		----		----
Magazines		1.7				----		----
Strong Paper		3.8				----		----
Mixed Paper		19.5		23.73		----		----
Inert	3.4			----	1.0		1.5	
Glass	8.5		9.55		10.9		10.0	
Metals	11.1		8.48		10.8			----
Magnetic		9.8		----		----		----
Non-Magnetic		1.3		----		----		----
Non-fiber organic	37.0		39.43		31.8		40.6	
Textiles		----		3.14		1.3		1.6
Food		----		10.93		25.9		14.2
Garden		----		20.80		1.9		18.3
Plastics/rubber/leather		----		4.56		2.7		6.5

* Average of 18 hand sorts

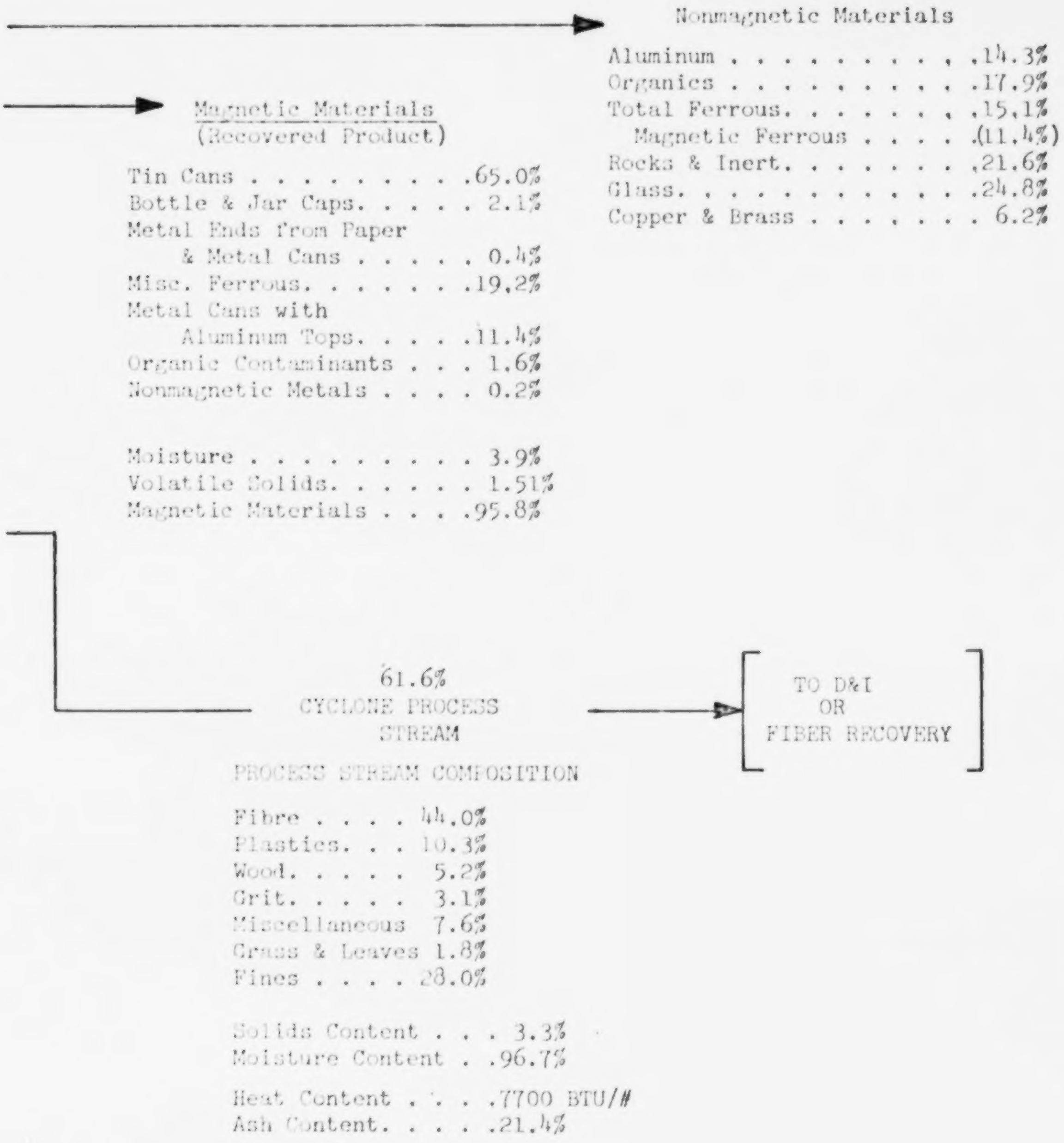
** Values from Municipal Refuse Disposal, Public Administration Service 1970, Interstate Printers and Publisher- Inc., Danville, Illinois.

*** Values from Energy Conservation through "Improved Solid Waste Management," by Robert A. Lowe, Office of Solid Waste Management Programs U.S. EPA April 1974.


JUNK REMOVER
MAGNETIC SEPARATOR
6.2%
9.6%
UNPROCESSABLE TIRES WHITE GOODS, INDUSTRIAL WASTE
7.5%
15.8%
INPUT REFUSE
HYDRAPULPER
WHITEWATER SYSTEM
AVERAGE VALVES
INERT 3.4%
NON FIBRE . .37.0%
ORGANIC
GLASS . . . 8.5%
MAGNETIC
METALS. . . 9.8%
NONMAGNETIC
METALS . 1.3%
NEWSPAPER . .10.8%
CORRUGATED. . 4.4%
MAGAZINES . . 1.7%
STRONG PAPER. 3.8%
MIXED PAPER .19.5%
40.2%
AVERAGE MOISTURE. . .29.4%
76.5%
PROCESS WATER
CYCLONE
61.6%
CYCLONE PROCESS STREAM
CYCLONE REJECTS
OVERFLOW
15.2%
CYCLONE REJECTS
-REJECTS COMPOSITION ON A DRY WEIGHT BASIS
CLEAR GLASS. 36.3%
AMBER GLASS. 13.1%
GREEN GLASS. 7.7%
MAGNETIC MATERIALS 8.6%
CERAMICS & STONES. 10.0%
ALUMINUM 3.4%
PLASTICS & RUBBER. 4.8%
WOOD & ORGANICS. 3.9%
FINES. 12.6%
DENSITY. . . . . 1.19 gr/cc
MOISTURE 11.1%
VOLATILE
MATTER 6.4%
TO GLASS PLANT
SIZE DISTRIBUTION
< 1/4" 30.0%
1/4" ≤ 3/4" 60.2%
> 3/4" 9.8%

NOTES:

1. Percentage values shown on lines connecting unit processes represent the percent input refuse on a dry weight basis. These values are actual measures of input streams and, therefore, summation of these values might not equal input values. The differences are negligible in most cases.
2. Percentage values on individual stream characterization data represent the percent of that component in the process stream.
3. Composition data should not be used with mass balances as composition data reflects average data.



Nonmagnetic Materials

Aluminum	14.3%
Organics	17.9%
Total Ferrous	15.1%
Magnetic Ferrous	(11.4%)
Rocks & Inert	21.6%
Glass	24.8%
Copper & Brass	6.2%

Magnetic Materials
(Recovered Product)

Tin Cans	65.0%
Bottle & Jar Caps	2.1%
Metal Ends from Paper & Metal Cans	0.4%
Misc. Ferrous	19.2%
Metal Cans with Aluminum Tops	11.4%
Organic Contaminants	1.6%
Nonmagnetic Metals	0.2%
Moisture	3.9%
Volatile Solids	1.51%
Magnetic Materials	95.8%

61.6%
CYCLONE PROCESS
STREAM

TO D&I
OR
FIBER RECOVERY

PROCESS STREAM COMPOSITION

Fibre	44.0%
Plastics	10.3%
Wood	5.2%
Grit	3.1%
Miscellaneous	7.6%
Grass & Leaves	1.8%
Fines	28.0%
Solids Content	3.3%
Moisture Content	96.7%
Heat Content	7700 BTU/#
Ash Content	21.4%

FIGURE 11

PULPING AND SEPARATION SUBSYSTEM STREAM CHARACTERIZATION waste is lower than that encountered in the two other cities but higher than the national average. This may be due in part to the communities' limited number of offices and related high paper consumption businesses as well as the presence of only a weekly newspaper. Springboro (also serviced by the solid waste plant) has no newspaper. This table indicates that the Franklin refuse is not significantly different than the national average composition. Table 2 presents a description of the materials included in each category used in sorting the input refuse. As is evident from this list, most of the nonmagnetic metals are aluminum.

Figure 13 presents the composition of the refuse at Franklin at different seasons of the year. Based on this data we can make some general observations on the seasonal variation of the refuse composition. The amount of paper present in the input increased from 32.9% to 49.4% from spring to winter. At the same time, the non-fiber organics decreased from 44.2% to 29.5%. This is primarily due to a drop in the garden waste during the winter months. Additionally, there is a low demand for recycled paper in this area, whereas this was not the case during the initial months of the study. The percentage of inert, glass, and metal remained virtually the same for all three time periods.

The moisture content appeared to be the lowest (17.7%) during a cold week in February and the highest (38.3%) during a rainy week in April. The average moisture during this period was 29.4%.

The test procedures used for the analysis of the input refuse are given in the Appendix. The amounts of industrial and domestic (residential) refuse are not recorded on a routine basis at the Franklin Plant.

Summary data sheets and raw data used for determining average characteristics of the streams in Figure 11 are given in the Appendix (Section C).

In analyzing the data presented in Figure 11 it should be noted that the actual percentages of magnetics and glass outputs of the P & S subsystem approximate the amounts found in the input refuse. For example, the sum of the amounts of magnetic material in the junk remover magnetic rejects and the magnetic materials in the cyclone rejects, is within 6.5% of the average of magnetic material in the input refuse as determined by hand sorts. This comparison of two separate magnetic determinations gives an indication of the accuracy of the methods used.

Table 2 - TYPICAL COMPOSITION OF SOLID WASTE CATEGORIES FOUND IN INPUT TO THE FRANKLIN SOLID WASTE PLANT

INERT

Rocks
Batteries
Dirt
Ceramics

NON-FIBER ORGANIC

Plastic Bags
Rubber
Clothing & Cloths

DIAPERS

Grass Clippings
Wood Products & Branches
Sanitary Napkins
Egg Cartons (Plastic Foam)
Vegetable Peelings & Vegetable Food & Garden
Plastic Bottles

GLASS

Beer Bottles
Light Bulbs
Broken Glass
Deodorant Bottles (Mostly amber Glass)

MAGNETIC METALS

Lamp Shades
Coat Hangers
Cans
Mufflers
Leaf Car Springs

NON-MAGNETIC METALS

Beverage Cans
Food Cans
Aluminum Foil
Aluminum Pie Pans
Toothpaste Containers
Pop Tops From Cans
Mixed red and white Metals

Table 2a - TYPICAL COMPOSITION OF SOLID WASTE CATEGORIES FOUND IN INPUT TO THE FRANKLIN SOLID WASTE PLANT

PAPER

Newspaper

Newsprint & Food Ads

Corrugated

Cardboard Boxes
Pizza Platters

Strong Paper

Both white & brown strong paper
Grocery & lunch bags (mostly brown bags)

Magazines

All Magazines

OTHER MIXED

Milk Cartons
Food Containers
Paper Towels
Napkins
Stationary
Medicine Cartons
Carbon Paper
Egg Cartons
Beer Cartons

Figure 13 - SEASONAL VARIATION OF REFUSE COMPOSITION

FRANKLIN, OHIO*

SORT DATES

CATEGORY	4/10-4/18/74	9/17-9/23/74	12/16-12/ /74	Average
Paper	33.8	37.34	49.4	40.1
Newspaper	6.83	13.48	12.1	10.8
Corrugated	2.5	5.80	4.9	4.4
Magazines	1.5	2.17	1.3	1.7
Strong Paper	3.86	3.71	3.8	3.8
Mixed Paper	19.12	12.18	27.3	19.5
Inert	2.5	5.18	2.4	3.4
Glass	9.7	7.94	8.0	8.5
Metals	10.7	11.88	10.7	11.1
Magnetic	10.05	10.10	9.3	9.8
Non-Magnetic	.62	1.78	1.4	1.3
Non-fiber organics	44.2	37.39	29.5	37.0

*Values in percent

Another comparison can be drawn between the glass content in the P & S outputs and the percentage of glass in the input refuse. The clear glass averages 37.4 percent, the green glass 7.7 percent, and amber glass 13.1 percent of the cyclone rejects stream. These values sum to 58.2 percent of the cyclone rejects stream which is 15.2 percent of the input refuse. From this it is evident that the glass fraction in the input refuse is expected to be 8.8 percent, based on the input to the glass plant. Actual refuse sorts indicate a glass fraction of 8.5 percent.

As a result of these comparisons, it can be safely stated that the composition on the outputs of the P & S subsystem can be extrapolated back to the components in the input refuse. This indeed was the procedure used in obtaining the moisture content in the received refuse. To obtain the moisture content all the dry solids outputs to the subsystem were summed up and subtracted from the wet weight of material input to the pulper. The difference between the dry outputs and wet weight input is the moisture content of the refuse.

5.2.3 Description of Pulping and Separation Streams

5.2.3.1 Hydrapulper Junk Process Streams - The hydrapulper junk process stream contains the non-pulpable or non-friable materials removed from the hydrapulper by the junk remover. This process stream typically contains bones, rubber materials, metal cans, metallic materials, rocks, leather, small amounts of plastic and fibrous matter, etc. The material contained in this process stream is saturated with water. As it passes from the junk remover to the magnetic belt separator much of the water drains off.

5.2.3.2 Magnetic Separator/Magnetic Rejects - This material contains the magnetic portion of the junk remover process stream. This magnetic material is combined with the magnetic material recovered in the glass plant, and sold to a ferrous metal reclaimer. The magnetic rejects have a moisture content of 3.9% and a volatile solids content (organic content) of 1.51%. From visual inspections, the organic content appears to be grass, fibrous, and plastic materials entrapped in the deformed magnetic materials. The percentage (by weight) of magnetic material in the magnetic rejects varies between 95 to 98 percent. This recovered product consists primarily of balled metal cans, portions of spark plugs, metal plates, muffler clamps, can and bottle tops, tubing, and small amount of organic matter, aluminum and glass.

5.2.3.3 Magnetic Separator/Non-Magnetic Rejects - This material contains the non-magnetic portion of the junk remover process stream. This stream consists of water saturated metallic and non-metallic items still containing approximately 11.4 percent magnetic materials. A visual inspection of the non-magnetic reject stream indicates approximately 50 percent by volume of the stream is organic matter. Typical items found in the organic fraction include: bones, fibrous matter, rubber tubing, and rubber material. Other components are aluminum cans, stainless steel, rocks and glass.

5.2.3.4 Cyclone Reject Stream - The cyclone reject stream contains the heavy material removed from the hydrapulper process stream. This stream is predominantly glass (57.1%) and it is the input material for the glass plant. The stream typically contains 11.1 percent water and 6.4 percent volatile solids (organic matter). It is composed of the following types of material: paper clips, aluminum, aluminum foil, bubble gum, wire, rubber, stone, and all types of glass. Most of the material is less than 1" diameter, and has a density of approximately 1.19 g/cc (74.22 lb/ft^3). A typical particle size distribution is presented below.

Particle Size	% By Weight
< 1/4"	30.0%
1/4" to 3/4"	60.2%
> 3/4"	9.8%

5.2.3.5 Cyclone Process Stream - The cyclone process stream contains the lighter portion of the hydrapulper process stream and is the input to the Fiber Recovery System. The cyclone process stream has an average total solids concentration of approximately 3.3% with a measured low of 1.5% and a measured high of 4.1%. The suspended solids concentration is approximately 2.4%. The heat content of the cyclone process stream is 7700 BTU/lb on an oven dry basis. On an "as received" basis the stream contains 97% moisture and will not support its own combustion. A net heat input of 739 BTU/lb is required to achieve combustion. The ash content is 21.4% of the total solids content on a dry weight basis.

The cyclone process stream can be described as a dark, grayish brown liquid containing large amounts (~500 ml/l) of settleable material. The majority of solid material is fibrous matter, but pieces of plastics, vegetable matter, small pieces of aluminum foil, paint flecks, straw, etc. can be distinguished in the process stream.

5.2.3.6 Whitewater and Process Water Characteristics - Table 3 Whitewater Characteristics, presents the average parameters for the whitewater system. The whitewater is used in the hydrapulper to produce a refuse slurry, and is used as dilution water in the Fiber Recovery System.

Table 3 - WHITEWATER CHARACTERISTICS

PARAMETER	UNITS	AVERAGE VALUE
Water Temp.	Cent.	26.0
Dissolved Oxygen	mg/l	5.8
Turbidity Lab	JTU	2460.0
Conductivity Lab	Micro-MHO	2660.0
pH Lab	S.U.	5.2
Alkalinity	mg/l	300.0
Hardness	mg/l	907.0
Chlorides	mg/l	341.0
Sulfates	mg/l	663.0
Total Solids	mg/l	9450.0
Dissolved Solids	mg/l	5060.0
Suspended Solids	mg/l	4390.0
Ammonia Nitrogen	mg/l	19.0
Nitrate Nitrogen	mg/l	2.0
Total Phosphorus	mg/l	58.5
C-BOD2	mg/l	1652.0
C-BOD5	mg/l	3225.0
C-BOD7	mg/l	3714.0
C-BOD10	mg/l	4267.0
C-BOD15	mg/l	4971.0
C-BOD20	mg/l	5493.0
TOC	mg/l	2213.0
COD	mg/l	8860.0

WHITEWATER CHARACTERISTICS

Bacteriological Data

PARAMETER	UNITS	AVERAGE VALUE
Fecal Coliform	#/100ml	1.3×10^7
Total Coliform	#/100ml	2.0×10^8
Total Plate Count	#/1ml	2.8×10^7

Heavy Metal Data

PARAMETER	UNITS	AVERAGE VALUE
Cadmium	ug/l	92.5
Manganese	ug/l	495.0
Zinc	ug/l	557.0
Nickel	ug/l	3990.0
Iron	ug/l	3900.0
Lead	ug/l	6225.0
Tin	ug/l	190.0
Chromium	ug/l	700.0
Copper	ug/l	11.4

High quality water is not required for pulping the refuse. The whitewater is continuously recirculated to reduce the water consumption. During the recirculation of this whitewater the concentration of solids, dissolved metals, bacteria, etc., reach equilibrium conditions. By way of comparison, the whitewater (although not a waste stream) is similar in strength to a concentrated industrial waste stream. As indicated previously, an average of 4890 gallons of whitewater is used per ton of refuse processed in the pulping and separation subsystems. The amount of whitewater used to process a ton of refuse is somewhat dependent upon the moisture content of the refuse processed. A lower moisture content requires a larger amount of whitewater to achieve the same consistency.

The bacteriological data for the whitewater listed in Table 3 indicates a high degree of bacterial contamination. The use of this contaminated water for processing could present potential health hazards if it were handled improperly. Precautions used in the handling of whitewater should be similar to those used in the handling of sewage.

The data presented in Table 3 for the Whitewater system, indicates that the whitewater contains more than average amounts of heavy metals (see page 105).

Process water is the chlorinated final effluent of the Miami Conservancy District's Regional Wastewater Treatment Plant. The characteristics of the process water are given in Table 4.

The average values indicate that the effluent from the Franklin Solid Waste Treatment Plant is of a high quality. As seen in the table, the average suspended solids are 51 mg/l and the average BOD_5 is 18 mg/l. It could be said that the suspended solids material is largely inert and does not exhibit as much oxygen demand as normal organic materials. This indicates that the percent of inerts in the suspended solids is fairly high. An average COD of 174 mg/l with an average BOD_5 of 18 mg/l indicates that the material in the final effluent is not subject to biological degradation as much as normal domestic sewage. This combined with the high dissolved solids content, would seem to indicate that there was a chemical demand in the waste that would not show up by consuming dissolved oxygen in the BOD tests. It should be noted that nitrification is occuring in the treatment facility. The ammonia nitrogen is 2.3 mg/l and the nitrate nitrogen is 5-1/4 mg/l; nitrification is significant. The final effluent could be considered to have a low nitrogen content.

5.2.3.7 Pulping and Separation Subsystem Water Requirements
As stated in the section, there are two inputs to the

Table 4 - PROCESS WATER CHARACTERISTICS

PARAMETER	UNITS	MAXIMUM	MINIMUM	AVERAGE
Water Temp.	Cent.	28.1	6.3	20.5
Dissolved Oxygen	mg/l	11.4	5.1	8.2
Turbidity Lab	JTU	60.0	6.0	21.4
Conductivity Lab	Micro-MHO	2173.0	1440.0	1603.9
pH Lab	S.U.	8.5	7.1	7.8
Alkalinity	mg/l	544.0	142.0	407.0
Hardness	mg/l	710.0	196.0	451.9
Chlorides	mg/l	224.0	162.0	193.0
Sulfates	mg/l	220.0	70.0	156.2
Total Solids	mg/l	1525.0	1037.0	1188.4
Dissolved Solids	mg/l	1449.0	987.0	1138.4
Suspended Solids	mg/l	121.0	1.0	51.0
Ammonia Nitrogen	mg/l	44.0	0.0	7.7
Organic Nitrogen	mg/l	3.1	0.1	2.3
Nitrate Nitrogen	mg/l	22.0	0.0	5.3
Total Phosphorus	mg/l	3.7	0.1	1.2
C-BOD2	mg/l	110.0	0.6	8.4
C-BOD5	mg/l	176.0	2.5	18.4
C-BOD7	mg/l	182.0	5.0	25.5
C-BOD10	mg/l	214.0	7.3	35.2
C-BOD15	mg/l	282.0	9.0	53.7
C-BOD20	mg/l	292.0	10.2	70.0
N-BOD5	mg/l	9.8	8.5	9.2
TOC	mg/l	140.0	25.0	50.9
COD	mg/l	431.0	70.0	174.3

P & S subsystem in addition to the refuse. These are the process water, and the whitewater. The whitewater is used in the P & S subsystem as input to the pulper to form the refuse slurry. Process water is used to cool the oil supply to the pulper and as elutriation water in the cyclone. The total quantity of water used varies with the quantity of refuse processed. The amount of process water used varies directly with operating time for the subsystem. The amount of whitewater used varies directly with operating time and moisture content of the input refuse.

Figures 14 & 15 respectively gives the whitewater and processed water usage per time. These figures also present a plot of water usage/ton processed during the study period.

The quantity of whitewater used in the P & S subsystem averages 4,860 gallons/ton processed. The amounts of whitewater used can be varied by the plant operator. For routine operating conditions the maximum and minimum amounts of whitewater used/ton of refuse processed are 7,340 and 2,680 gallons respectively. Increased whitewater usage results in higher dilution of the refuse slurry produced.

The quantities of process water used in the P & S subsystem are a function of the operating time of the system. The quantity of process water used/ton of refuse processed averages 1,630 gallons. This volume was observed to vary between 2,700 gallons/ton and 1,630 gallons/ton.

5.2.3.8 Power Requirements for the P & S Subsystem - Figure 16 represents the kilowatt hours used by the hydrapulper and the average kilowatt hours used by the hydrapulper per ton refuse processed. The average power usage by the hydrapulper was 32.5 kilowatt hours per ton with a maximum and minimum of 46.4 and 22.8 kwh/ton respectively. The variation in the kilowatt hours required per ton of refuse processed can be attributed to several variables. These variables include: the consistency of the input refuse; the moisture content of the input refuse; and the condition of the pulper rotor. As the hammers on the pulper rotor become dull, the time required to pulp the refuse increases, as does the power required to pulp a ton of refuse. No estimates can be made regarding the consistency of the input refuse, and the difficulty in pulping a given quantity of refuse.

The power usage in the P & S subsystem is largely due to the hydrapulper. The hydrapulper is driven by a 300 horsepower motor, and the oil pump supplying oil to the pulper motor has a 1 horsepower pump. These power requirements represent more than all the other connected horsepower in the P & S subsystem.

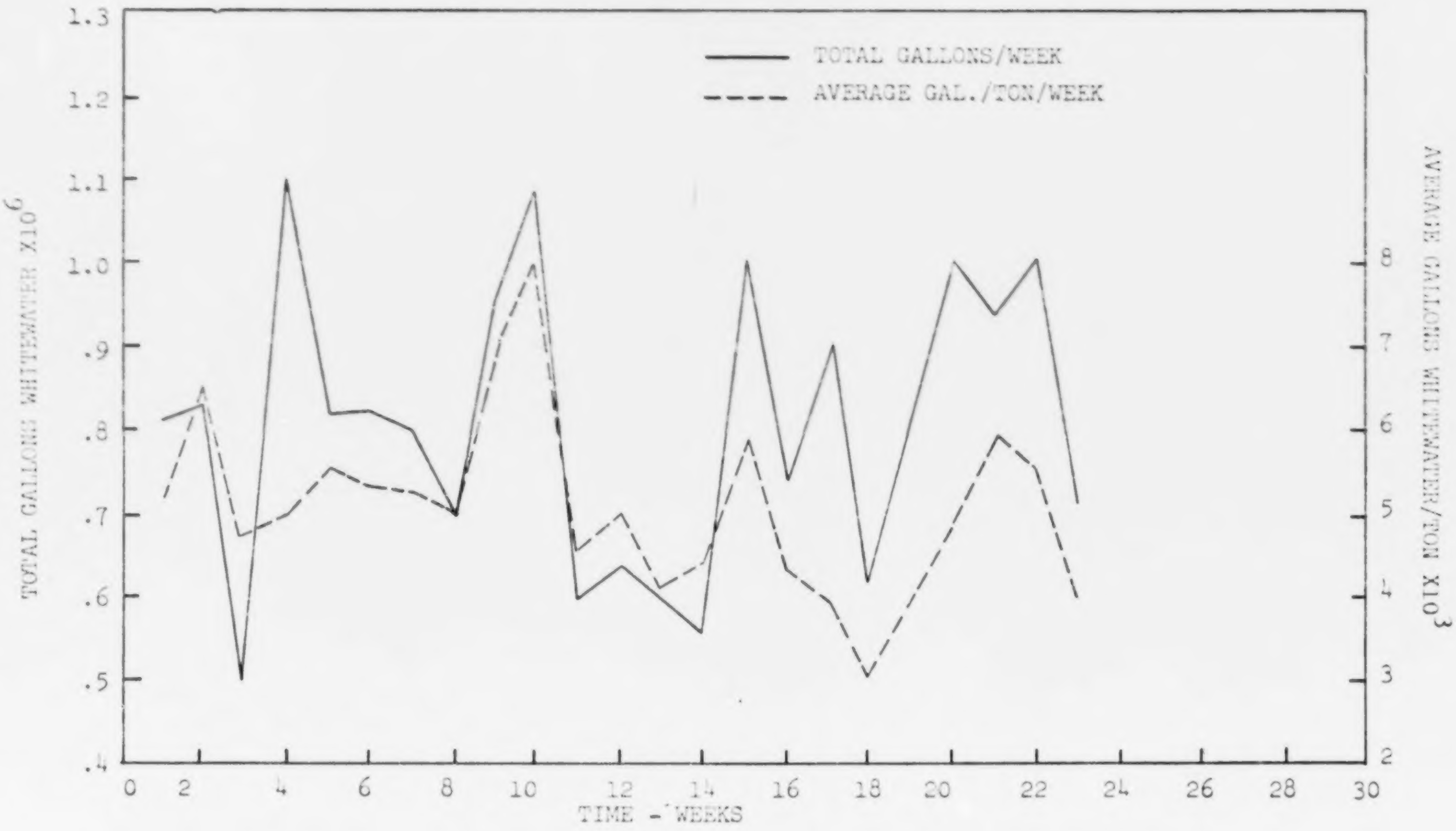


FIGURE 14 - WHITEWATER CONSUMPTION, PULPING & SEPARATION SUBSYSTEM

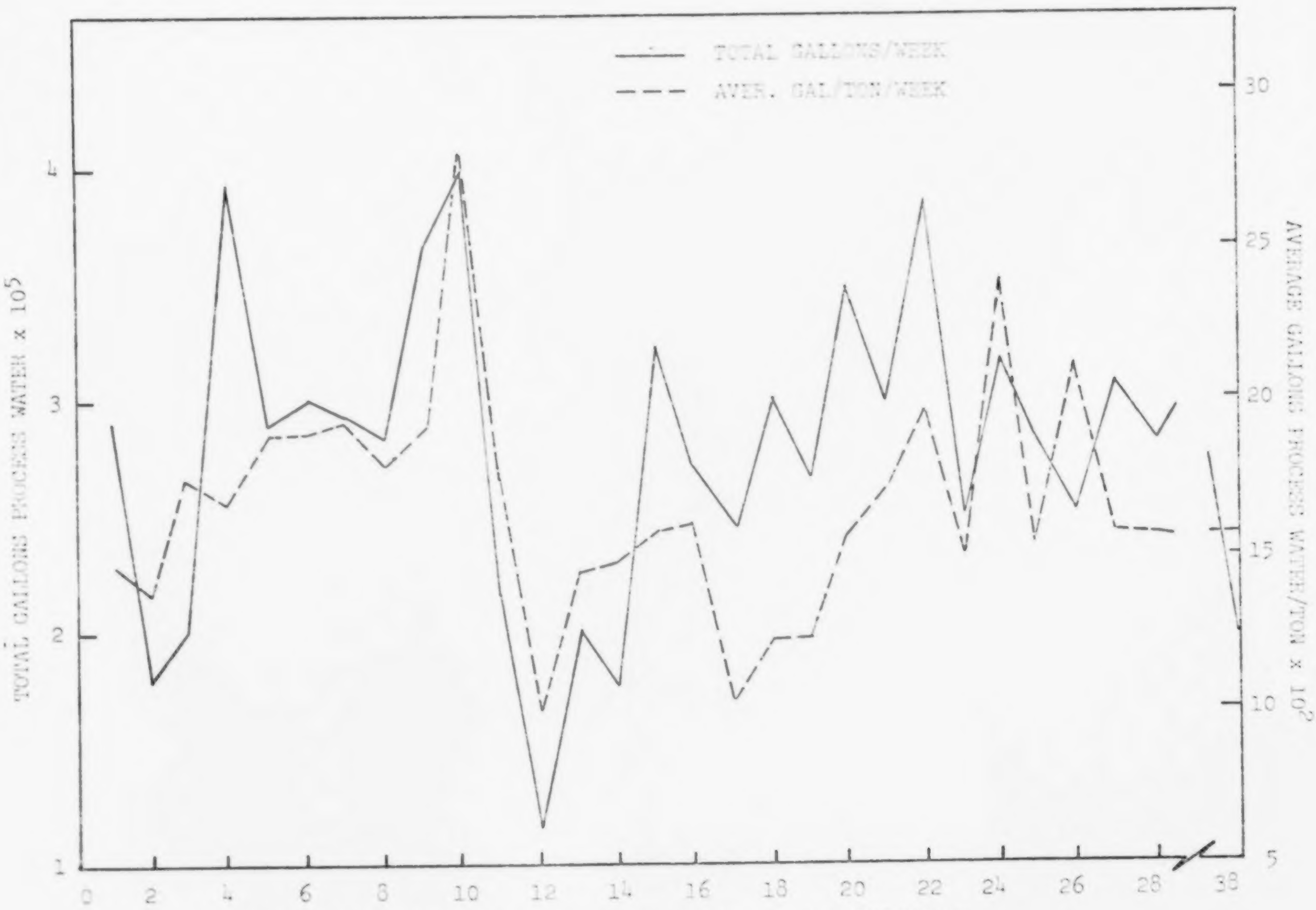


FIGURE 15 - PROCESS WATER CONSUMPTION - P & S SUBSYCTEM

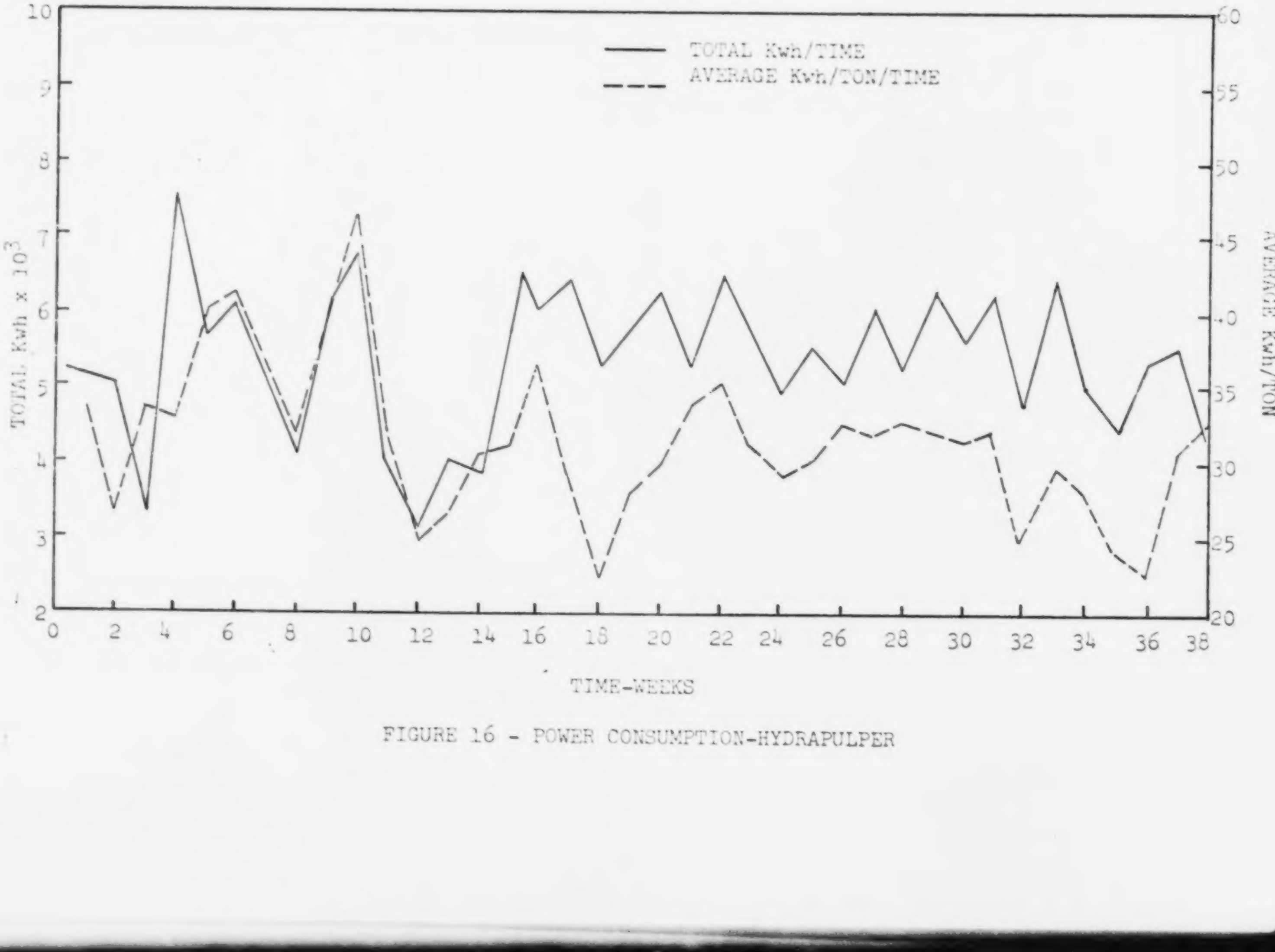


FIGURE 16 - POWER CONSUMPTION-HYDRAPULPER

The hydrapulper power consumption was recorded by a separate kilowatt hour meter. The major power usage items in the P & S system are given as follows:

ITEM	HORSEPOWER
Conveyor	10
Hydrapulper	301
Junk Remover	10
Hydrapulper Dump Pump	30
Junk Washer	1
Magnetic Separator	5
Cyclone Recycle Pump	15
Dewatering Screw for Glass Plant	2

Based on horsepower ratings the hydrapulper uses 81 percent of the power in the P & S subsystem.

5.2.3.9 *Efficiency of Equipment* - As shown in the Study Matrix (Figure 6) the only unit processes within the P & S subsystem that can be evaluated in terms of efficiency are the magnetic separator and the liquid cyclone.

The magnetic separator is a rotating magnetic belt which separates the junk remover reject stream according to magnetic and non-magnetic items. The magnetic separator removed 92.8 percent of the magnetic materials extracted from the hydrapulper by the junk remover. It should be noted that the recovered magnetics were contaminated with other materials because of mechanical attachments. The contaminants amounted to 4.2% of the magnetic reject stream. The non-magnetic rejects which were landfilled or recycled to the head of the plant, contained about 11.4% magnetic material, as determined by manual sorting. There are two reasons for this high percentage of magnetics in the non-magnetic bin: (1) Some magnetic items in the non-magnetic bin were too heavy to be extracted by the separator, (2) The percentage of magnetics in a particular mass of material was too low to be affected by the magnetic belt.

The input to the liquid cyclone is the hydrapulper process stream. The cyclone separates the glass and gritty material in the hydrapulper process stream from the fibrous matter.

The cyclone process stream was analyzed to determine the amount of grit that was not removed by the process. Based on the results of grit analysis tests, it was determined that the cyclone was 72% efficient in the removal of grit. However, hand sorts of the cyclone process stream indicated that all the glass particles greater than 1/8" were being removed by the cyclone. This would indicate that the cyclone is effective in removing the usable glass particles and that only small glass particles and other small grit escape the cyclone. A fractional efficiency curve is not available for this cyclone. None is available from the manufacturer and we did not develop one during the course of the study. Development of a fractional efficiency curve would have presented several problems and would involve a considerable effort. The amount of gritty material which is removed by the cyclone is a variable and is dependent on several factors.

(1) The consistency (percent solids) of the feed material to the cyclone; e.g., the higher the consistency, the greater the viscosity and the lower the removal efficiency of the cyclone;

(2) The specific gravity of the grit being removed; and

(3) The grit particle's size and shape.

Black-Clawson claims that all materials greater than 40 mesh are being removed by the cyclone. This is apparently true from our observations of the material collected on a 200 mesh screen. On this basis the cyclone can be said to have 100% removal efficiency of grit particles greater than 40 mesh (0.0635 cm, 0.025 inches). One exception to the 100% removal efficiency of that particle size is the occasional appearance of shredded aluminum foil and aluminum can tabs. It is obvious that this material is greater than 40 mesh but its shape and specific gravity are such that removal is not possible in the cyclone. However, true grit such as glass and rocks are effectively removed by the cyclone.

5.3 DEWATERING and INCINERATION (D & I) SUBSYSTEM

The D & I subsystem dewaters and incinerates the unuseable portion (rejects) of the Fiber Recovery System, or the entire process stream from the P & S subsystem.

When the fiber is not being recovered, the input to the D & I subsystem is the cyclone process stream (directly) or the partially dewatered cyclone process stream (via "thickening" mode). The Fiber Recovery reject streams, or the cyclone process stream enter the surge chest, and are continuously agitated within it. The contents of the surge chest are then fed to the barrel thickeners. The barrel thickeners (3 in parallel) partially dewater the surge chest process stream. The partially dewatered refuse slurry is then transported by the screw conveyor to the cone press where it is further dewatered. The rejects from the barrel thickeners (primarily liquid) enter the whitewater system; the rejects from the cone press, because of the introduction of sewage sludge between the barrel thickeners and the cone press, are segregated and pumped to the Miami Conservancy District. At this point the material has been dewatered in the D & I subsystem to a point where it can support its own combustion. Thus, no auxilliary fuel is required for the incineration. The cone press process stream is fed to a pneumatic feeder which injects it into the bed of the fluid bed reactor.

The ashes and small sand particles that escape in the reactor exhaust gases are removed by a Venturi type scrubber. The ash slurry, as it is called at this point, is pumped to the Miami Conservancy District Wastewater Treatment Plant for treatment.

5.3.1 Material Balance Sheet for Dewatering & Incineration Subsystem

The material balance given in Figure 17 indicates the inputs and outputs to the D & I subsystem as well as the operating time for that subsystem. The values indicated on this balance sheet represent the actual operating data for an average week. These are average data and do not reflect the optimum operation of the plant. Optimum operation would have no material coming directly from the P & S subsystem and all of the material entering the D & I subsystem would be rejects from the Fiber Recovery System.

There are two major inputs to the D & I subsystem. These are: (1) the rejects from the Fiber Recovery System or, (2) the cyclone process stream from the P & S subsystem. The latter case occurs when the Fiber Recovery System is not operating. In this instance, the cyclone process stream can be "thickened" using some of the equipment in the Fiber Recovery System.

The inputs into the D & I subsystem are all the materials requiring final disposal, and the city water that is required for the scrubber operation. As indicated on Figure 17 the average input to the D & I subsystem is 74.5 tons per week. Of this, 39 tons are from the P & S subsystem (when Fiber Recovery System is not operating) representing 52.9% of the average input, 2.4% consists of sewage sludge and skimmings, and 33.3 tons or 44.7 percent from Fiber Recovery Operations. A minimal amount of process water is used in the D & I subsystem as cooling water for the bearings in the cone press. This is considered negligible for the purposes of this mass balance.

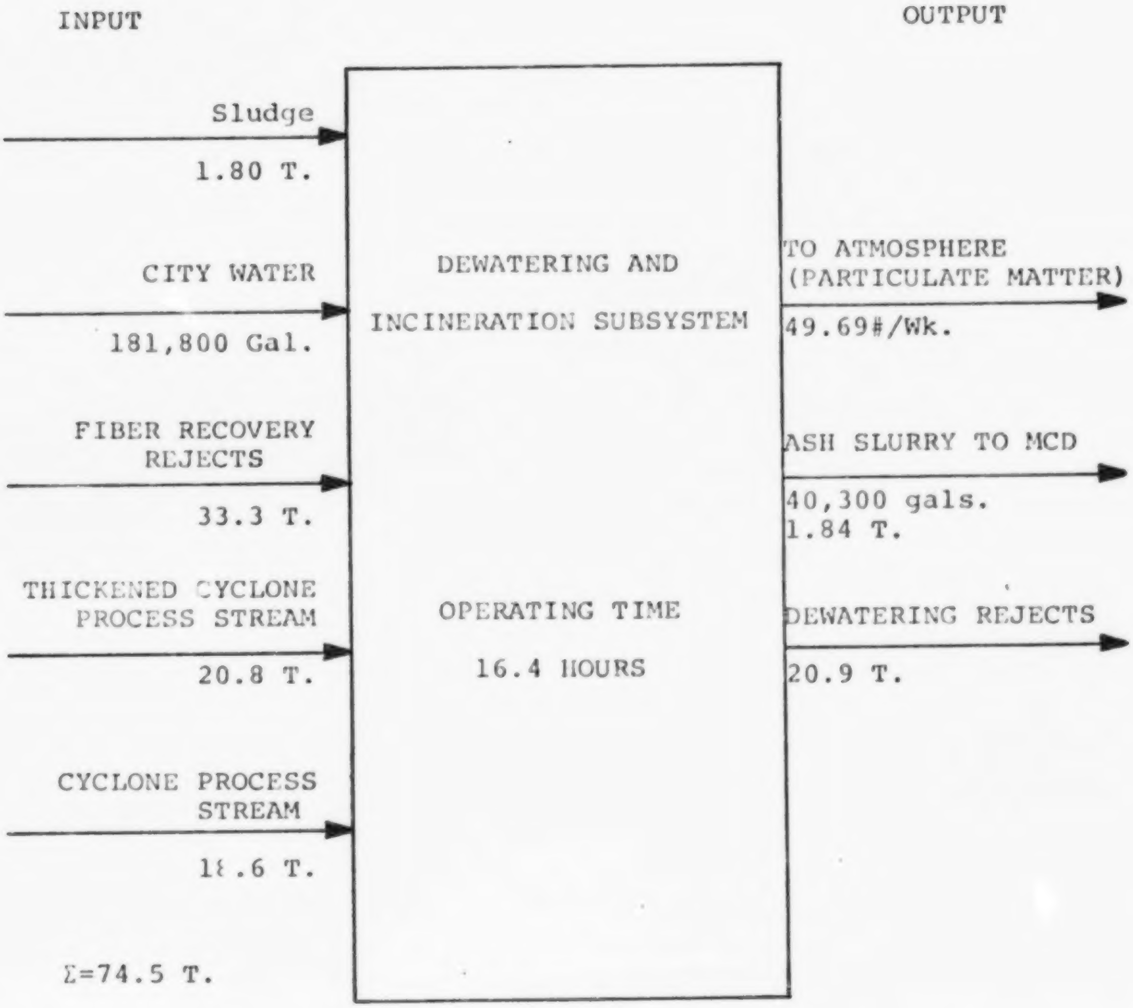

INPUT
OUTPUT
Sludge
1.80 T.
CITY WATER
181,800 Gal.
FIBER RECOVERY REJECTS
33.3 T.
THICKENED CYCLONE PROCESS STREAM
20.8 T.
CYCLONE PROCESS STREAM
18.6 T.
Σ=74.5 T.
DEWATERING AND INCINERATION SUBSYSTEM
OPERATING TIME
16.4 HOURS
TO ATMOSPHERE (PARTICULATE MATTER)
49.69#/Wk.
ASH SLURRY TO MCD
40,300 gals.
1.84 T.
DEWATERING REJECTS
20.9 T.

FIGURE 17 - MATERIAL BALANCE SHEET**
DEWATERING AND INCINERATION SUBSYSTEM

*All values are on a dry weight basis.

The outputs to the D & I subsystem consist of the output from the reactor to the atmosphere, the ash slurry to the Miami Conservancy District, and the whitewater which is obtained from dewatering the refuse slurry. This water enters the whitewater system and is reused.

A close comparison of the input tonnage and output tonnage on the D & I subsystem material balance sheet would indicate that the inputs are much greater than the outputs to that subsystem. This apparent discrepancy is due to the fact that the input tonnage is uncombusted refuse, whereas the output tonnage in the ash slurry is ash material. The balance of the mass is emitted as gases of combustion through the stack.

As is evident from Figure 17 the dewatering rejects from the barrel thickeners and the cone press account for 28% of the input tonnage. For the most part, this material is reintroduced to the whitewater system. A quantity of less than 33% of the liquid stream is removed from the sewage sump and pumped to the Miami Conservancy District for treatment. The City water used in the D & I subsystem is for the operation of the venturi scrubber. No input solids are given for this water because it is only used in the scrubber system and then transported to the Wastewater Treatment Plant. As a result, the actual value of solids input from the City water has not been included.

If the dewatering rejects are subtracted from the summation of the inputs to the subsystem, the reactor input can be calculated. For an average week's operation, the reactor input was 53.6 tons/week. From this, 1.84 tons of ash material was obtained. This would imply an average ash content of 3.4 percent, which is very low.

Results of laboratory testing indicates an ash content of approximately 10.8% (900°c, 45 min). There are several possible reasons for this discrepancy:

1) The laboratory methods for determining ash content may not approximate the actual combustion process.

2) The particulate emission tests were performed prior to this study and this data may not be representative.

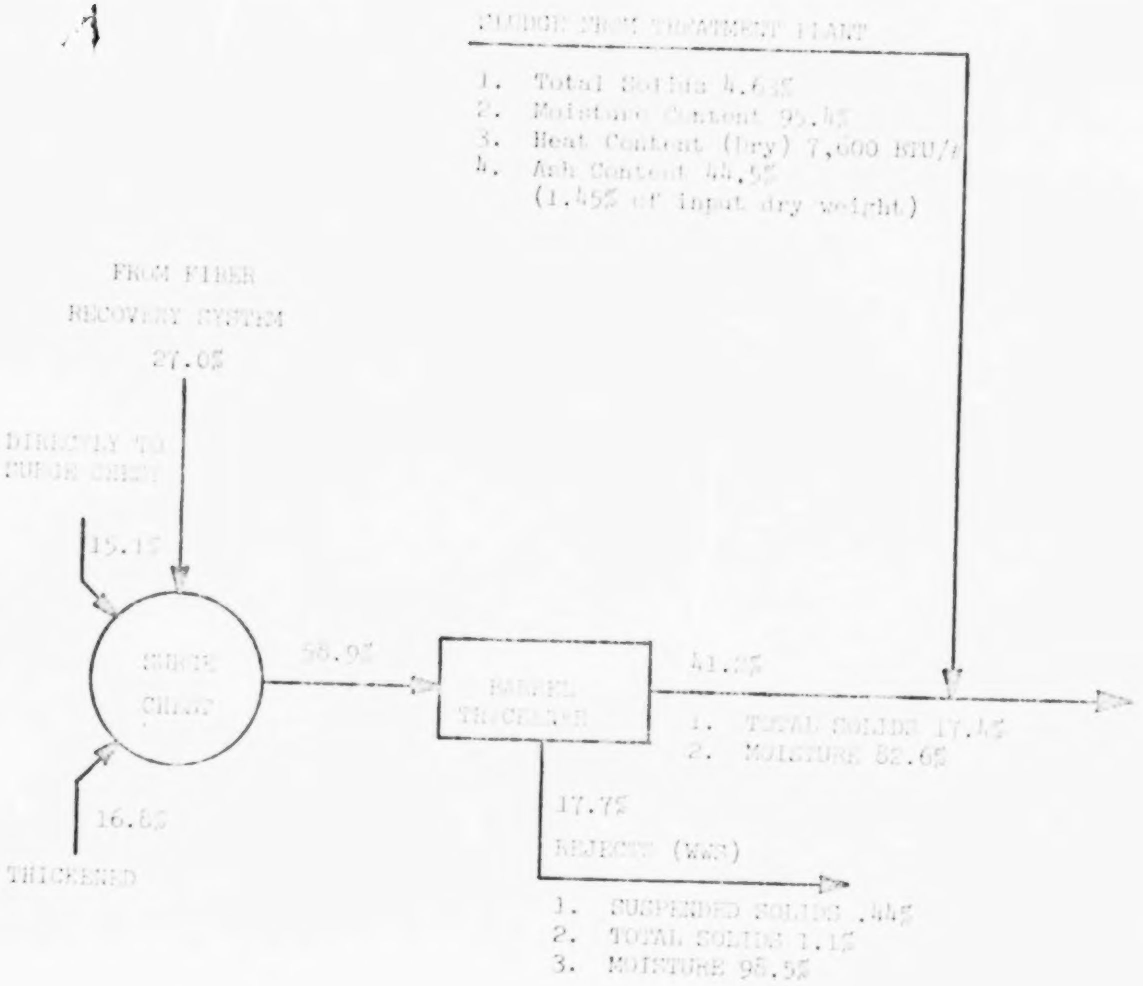
3) There were difficulties experienced in determining the total volume of ash slurry because of meter calibration problems, pump leaks, etc.

It is the opinion of the authors, that a reasonable estimate of the ash content of the material input to the reactor is the range of 10 to 12 percent.

5.3.2 Dewatering and Incineration Subsystem Stream Characteristics

The stream characteristics for the D & I subsystem for the period of our study, are given in Figure 18 These stream characteristics were obtained by (1) daily composite samples of processed streams, and (2) additional periodic analyses of the streams to obtain their individual characteristics. The characteristics of the exhaust gases were obtained from the final report published by Environmental Sciences Inc. Like the stream characterization sheet given for the P & S subsystem, this system is arranged in a flow type diagram. The arrows connecting the processes indicate the direction of flow of material in the system. The percentage values on the lines or arrows connecting the unit processes show the percent of input refuse, on a dry weight basis which flows along this route. We can see from Figure 18 that 58.9% of the input refuse is disposed of in the D & I subsystem. In the dewatering phase of this subsystem, 96.9% of the water and 30.8% of the solids are removed in the combined dewatering of the barrel thickeners and cone press. The cone press process stream has an average total solids content of 45%. This material has a sufficiently high heat content to support its own combustion at this point. A lower total solids content in the cone press process stream would reduce the heat given off by the combustion of this material. The fuel value required for continuous operation of the fluidizied bed reactor is approximately 3,000 BTU/lb. The cone press process stream, on a weight basis averages approximately 3,600 BTU/lb. and, thus, is high enough to support its own combustion. As is evident from the moisture content, the material drawn from the surge chest is a liquid stream; it is fed through the barrel thickeners and increased to a total solids content of 17.4% at which time it appears to be a fibrous solid. This material is further dewatered in the cone press to 45% moisture. This dryer solid still feels wet to touch.

When this material is incinerated an inert ash is formed. The resulting ash slurry has a very low carbonaceous oxygen demand. Hence this stream does not require biological treatment. During the period of our study, sewage sludge was introduced in the screw conveyor between the barrel thickener and the cone press (sludge is not added to the surge chest). This sludge averaged 4.6 percent solids and had a heat content of 7,600 BTU per pound on a dry weight basis. The ash content


SLUDGE FROM TREATMENT PLANT
1. Total Solids 4.63%
2. Moisture Content 95.4%
3. Heat Content (Dry) 7,600 BTU/#
4. Ash Content 44.5%
(1.45% of input dry weight)
FROM FIBER
RECOVERY SYSTEM
27.0%
DIRECTLY TO
SURGE CHEST
15.1%
16.8%
THICKENED
SURGE
CHEST
58.9%
BARREL
THICKENER
41.2%
1. TOTAL SOLIDS 17.4%
2. MOISTURE 82.6%
17.7%
REJECTS (WWS)
1. SUSPENDED SOLIDS .44%
2. TOTAL SOLIDS 1.1%
3. MOISTURE 98.5%

SURGE CHEST CONTENTS

Percent Moisture 96.5%
Total Solids 3.5%
Heat Content (DRY) 7,380 BTU/#
Ash Content 22%
Grit Content 9.5%

Total Coliform Count 165 x 10^6/100 ml
Fecal Coliform Count 10 x 10^6/100 ml
Total Plate Count 100 x 10^6/ml

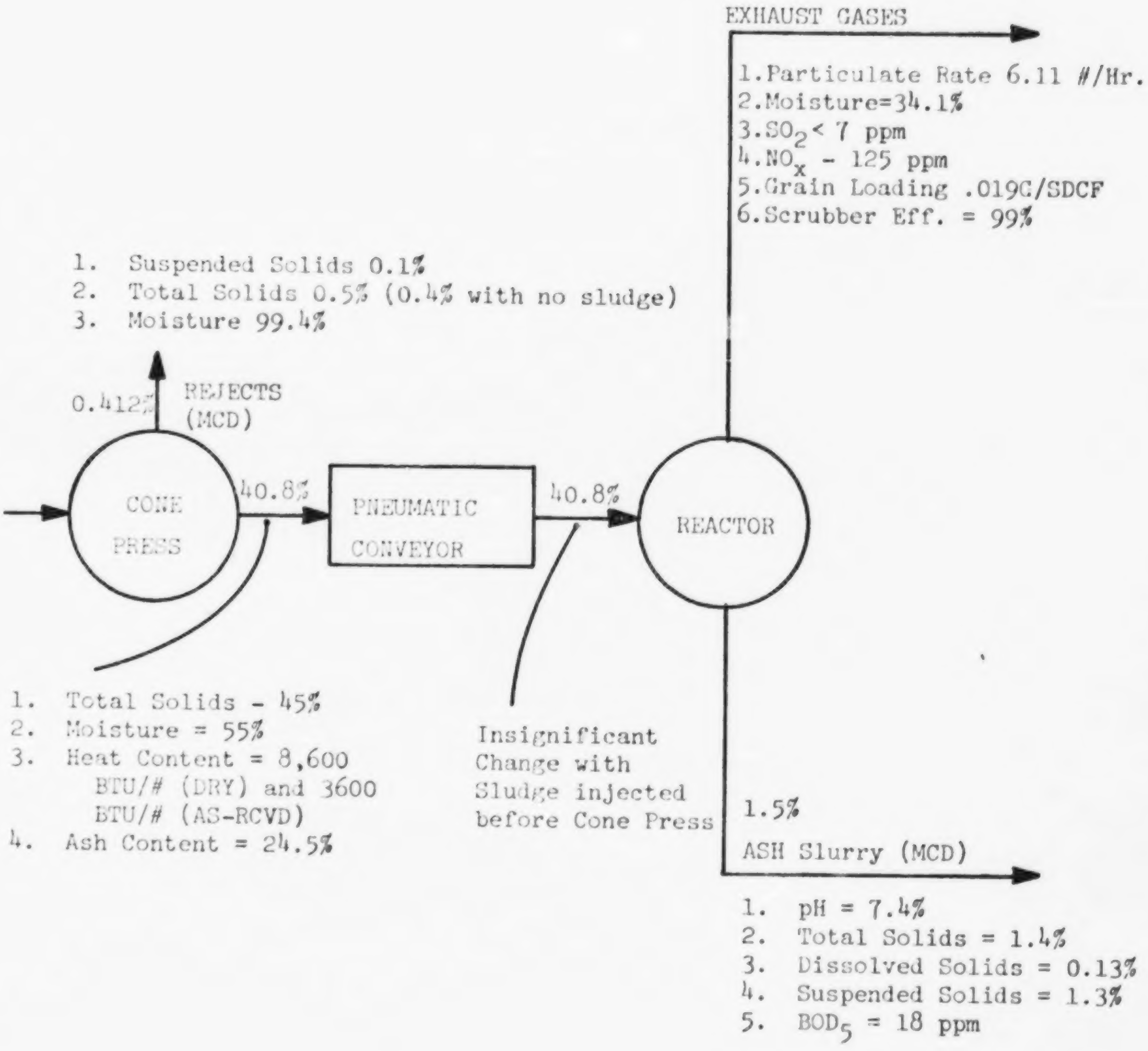

EXHAUST GASES
1.Particulate Rate 6.11 #/Hr.
2.Moisture=34.1%
3.SO_2< 7 ppm
4.NO_x - 125 ppm
5.Grain Loading .019G/SDCF
6.Scrubber Eff. = 99%
1. Suspended Solids 0.1%
2. Total Solids 0.5% (0.4% with no sludge)
3. Moisture 99.4%
0.412%
REJECTS (MCD)
CONE PRESS
40.8%
PNEUMATIC CONVEYOR
40.8%
REACTOR
1. Total Solids - 45%
2. Moisture = 55%
3. Heat Content = 8,600 BTU/# (DRY) and 3600 BTU/# (AS-RCVD)
4. Ash Content = 24.5%
Insignificant Change with Sludge injected before Cone Press
1.5%
ASH Slurry (MCD)
1. pH = 7.4%
2. Total Solids = 1.4%
3. Dissolved Solids = 0.13%
4. Suspended Solids = 1.3%
5. BOD_5 = 18 ppm

FIGURE 18- DEWATERING AND INCINERATION SUBSYSTEM STREAM CHARACTERIZATION DATA is extremely high for sludge. This is because the Miami Conservancy Treatment Plant does not have grit removal prior to primary clarification and as a result, all the suspended gritty particles which would be removed in the grit removal section of the treatment plant are removed in the primary section and contained in the sludge.

5.3.3 Description of Dewatering and Incineration Streams

5.3.3.1 Thickener Rejects Stream - The thickener reject stream is a grayish brown liquid containing a minor amount of settleable black solids and fibrous matter. The total solids content of the thickener reject stream ranges from 0.8% to 1.5% and the suspended solids content is approximately 0.4%.

5.3.3.2 Press Process Stream - As the material leaves the barrel thickener, it enters the cone press for further dewatering. The process stream from the press consists of grayish brown fibrous matter which contains visible amounts of grass, plastics, and small pieces of glass, wood, and string material.

The heat content of this material on an over-dry basis is 8,050 BTU/lb. The streams solid content varies from 36.6 to 49.5% solids. The heat content of this material on an "as-received" basis is 3,580 BTU/lb. and has an ash content of 24.5 percent.

5.3.3.3 Press Reject Stream - The press reject stream is a grey brown liquid containing a minute amount of settleable black material. The stream has a suspended solids concentration of 0.1%, a total solids content of 0.5%, and a moisture content of 99.4%.

5.3.4 Efficiency of Equipment in D&I Subsystem

As indicated on our Study Matrix, the only unit operation in the D & I subsystem that has a meaningful efficiency is the venturi scrubber. The efficiency of this scrubber has been determined by Environmental Sciences, Inc. This efficiency was determined by comparison of isokinetc samples taken on the input and output to the venturi scrubber. The average removal efficiency of solid particulate matter was 99.0%

5.3.5 Power Requirements for the D & I Subsystem

Power data for this complete subsystem could not be obtained. However, some general remarks can be made about the power consumed in this section of the plant. The D & I subsystem contains the following power using equipment (Table 5).

Table 5 - POWER USAGE OF EQUIPMENT ITEMS

DEWATERING & INCINERATION EQUIPMENT	HORSEPOWER CONNECTED
Surge Chest Agitator	50
Surge Chest Pump	25
Barrel Thickeners	45
Screw Conveyor	3
Whitewater Sump Pump	15
Sludge Chest Agitator	20
Sludge Pump	15
Cone Press	80
Sewage Sump Punp	15
Screw Conveyor	3
Rotary Valve	2
Pneumatic Feed	50
Reactor Blower	500
Ash Pump	15

As is evident from this list of major electrical equipment the major power requirement is for the fluidizing air blower. This one motor represents 60% of the installed horsepower in the subsystem. It is used to provide an air supply at sufficient pressure and volume to fluidize the sand bed and overcome the pressure drop (7.0 inches water) in the scrubber. An additional 8% of the installed horsepower in the D & I subsystem is used as supplemental equipment to the incinerator. The dewatering phase of the D & I sybsystem accounts for 23.6% of the installed horsepower used in the subsystem. A total of 198 horsepower is installed in the dewatering section of this subsystem. The thickener process stream varies in total solids from 12.0 to 24.4.

5.4 FIBER RECOVERY SYSTEM

The Fiber Recovery System receives the cyclone process stream from the P & S subsystem and recovers a portion of the useable fiber contained in it. This recovered fiber is diluted with process water and pumped to the Logan Long Company which uses this material as a substitute for other paper sources in manufacturing roofing felt. The reject streams, materials rejected in the recovery of the fiber, are from two sources: the selectifier, and the centrifugal cleaners. These materials flow into the rejects tank in the Fiber Recovery System and are then pumped to the surge chest in the D & I subsystem. The whitewater sump which contains rejects from the rundown screen enters the whitewater system. A portion of this flow is bled off to the Miami Conservancy Wastewater Treatment Plant for treatment.

5.4.1 Material Balance Sheet for the Fiber Recovery System

The material balance for the Fiber Recovery System is given in Figure 19. This figure indicates three inputs to the Fiber Recovery System and three outputs. The major input to the system is the cyclone process stream. This input contains all the fibrous materials that are recovered in the system. The whitewater is an intermittent input to the system and it is added to the selectifier dilution tank as needed.

The tonnage values given for the whitewater and process water represent actual dry solids input to the system contained in the whitewater and process water. All values on Figure 19 are given on a dry weight basis.

In Figure 19 the 15.5 tons/week represents the total solids output to Logan Long Company and the 13.6 tons Fiber represents the actual tonnage of fiber output, the suspended fiber material. The difference between these two values is the

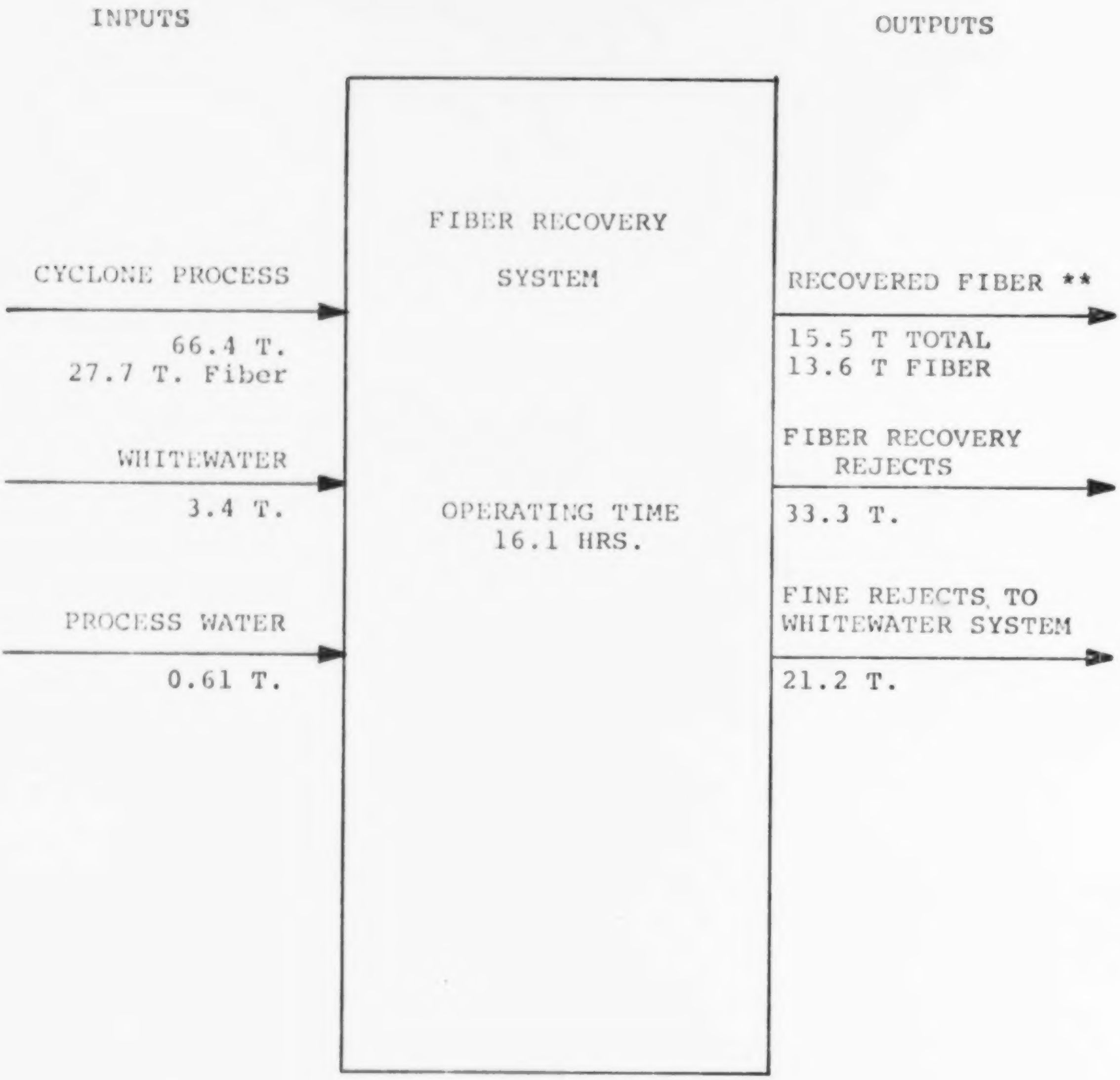

INPUTS
OUTPUTS
FIBER RECOVERY SYSTEM
CYCLONE PROCESS
66.4 T.
27.7 T. Fiber
WHITEWATER
3.4 T.
PROCESS WATER
0.61 T.
OPERATING TIME
16.1 HRS.
RECOVERED FIBER **
15.5 T TOTAL
13.6 T FIBER
FIBER RECOVERY REJECTS
33.3 T.
FINE REJECTS TO WHITEWATER SYSTEM
21.2 T.

FIGURE 19 - BALANCE SHEET FOR FIBER RECOVERY SYSTEM

*All values are on a Dry Wt. Basis. Figure represents actual operating data for an average week.

**Total tons includes dissolved solids in slurry.

dissolved solids contained in the fiber slurry. As can be seen in Figure 19, approximately 20 percent of the input tonnage in the cyclone process stream is recovered as fiber. Approximately 50% of the input tonnage to fiber recovery is removed in the form of rejects. This material requires final disposal in the D & I subsystem. The third output is the fines rejects to the whitewater system which consists of the rejects from the rundown screen, the barrel thickener and the cone press. This tonnage represents 32% of the tons input to the system.

The recovery of 13.6 tons fiber, or 20% of the tonnage input to the Fiber Recovery System, does not indicate a recovery rate for paper fiber. The tonnage in the cyclone process stream represents gross tons and not tons fiber input into the system. The fiber content in the cyclone process stream was approximately 27.7 tons/week. This would indicate a fiber recovery rate of 49.1%.

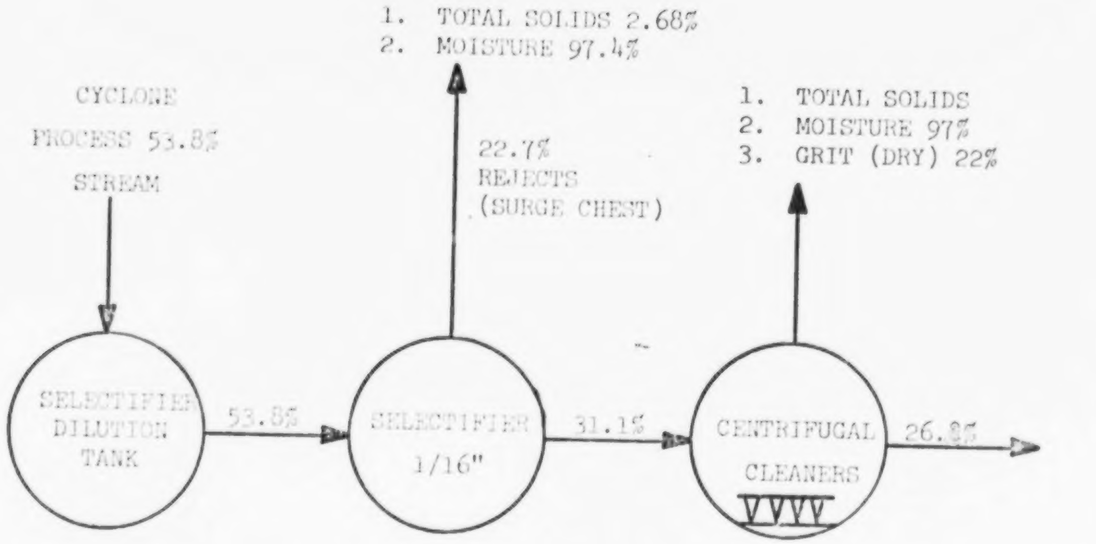
5.4.2 Stream Characteristics of the Fiber Recovery System

The stream characteristics of the Fiber Recovery System are given on Figure 20. These stream characteristics were obtained from daily composite samples of process streams which were necessary to achieve the daily mass balances. Additional information was derived from periodic tests which were performed on the individual streams within the entire plant. Some of the stream characterization tests were performed by the paper technology department of Miami University on the fibrous content of the cyclone process stream and the quality of the recovered fiber. The input to the Fiber Recovery System is the cyclone process stream. The characterization data for the cyclone process stream is given on the P & S subsystem characterization sheet as well. The characteristics of the whitewater and process water used in the Fiber Recovery System are the same given in the P & S subsystem.

This characterization sheet is presented in the same manner as the characterization sheets for the P & S and D & I subsystems in that the arrows connecting unit processes indicate the direction of the flow in the system and the percentage values written on these connecting arrows indicate the percent of input refuse which flows along that route.

The cyclone process stream based on handsort data contains 67.7% fiber, 12% plastics, 5.4% wood, 5% glass, .9% aluminum, and 9% miscellaneous. The heat content of this stream is 7,700 BTU/lb. on a dry weight basis. On a wet basis the BTU content is a -831 BTU/lb. The negative heat content indicates that the material would not support its own combustion. This is obvious from the high moisture content of 96.7% contained in the stream. The cyclone process stream enters the selectifier dilution tank where whitewater is added to reduce the consistency of the cyclone process stream if required. The characteristics of the whitewater are discussed in section 5.2.3.6. The selectifier dilution tank is agitated and a pump draws this material and feeds it to the selectifier. The selectifier is a rotating screen with 1/16" openings. The selectifier is intended to remove all the plastics, string and other materials longer than 1/16" in length or diameter. As is evident from the Fiber Recovery stream characterization sheet, 42% of the solid material is removed from the cyclone process stream by the selectifier. This represents the largest reject stream in the Fiber Recovery System.

Following the selectifier, the material enters a cleaners supply tank. The material is removed from the cleaners supply tank and fed to five centrifugal cleaners. Process water is used at this point as elutriation water in these cleaners. Process water characteristics are given in section 5.2.3.6. The cleaners serve to remove a portion of the larger gritty material found in the selectifier process stream. This gritty material is the second reject stream in the Fiber Recovery Process. It is combined with the selectifier reject stream in the rejects tank and pumped to the surge chest for final disposal in the D & I subsystem. The centrifugal cleaners process stream is fed directly to the rundown screen where material smaller than approximately .020" is removed. The rundown screens are similar to Hydrasieves that are sometimes used in place of primary treatment in wastewater treatment plants. The rejects from the rundown screen enter the whitewater system where there is a large bleedoff at this point to the Miami Conservancy District. This bleedoff is necessary to keep the percentage of fines and oil and grease materials low in the whitewater system. This is necessary to achieve a quality fiber usable by the Logan Long Company. The rundown screen process stream, is pumped to the barrel thickener which is smaller but similar to the dewatering device found in the D & I subsystem. This screw thickener concentrates the process stream from the rundown screen to 15% solids from 2.2% solids. Following the screw thickener is a cone press similar to that used as the second step in dewatering in the D & I subsystem. This concentrates the fiber stream to a solids concentration of approximately 45%. This material is then diluted by either process water or by a portion of the rundown screen process stream which bypasses the dewatering section of the Fiber Recovery System.


1. TOTAL SOLIDS 2.68%
2. MOISTURE 97.4%
CYCLONE
PROCESS 53.8%
STREAM
22.7%
REJECTS
(SURGE CHEST)
1. TOTAL SOLIDS
2. MOISTURE 97%
3. GRIT (DRY) 22%
SELECTIFIER
DILUTION
TANK
53.8%
SELECTIFIER
1/16"
31.1%
CENTRIFUGAL
CLEANERS
26.8%

1. TOTAL SOLIDS 1.92%
2. MOISTURE 98.1%
3. GRIT 10%
4. % > 1/16" = .77%

1. TOTAL SOLIDS 1.72%
2. MOISTURE 98.3%
3. GRIT CONTENT 10%

Total Solids 3.3%
  Fibre 67.7%
  Plastic 12.0%
  Wood 5.4%
  Glass 5.0%
  Aluminum .9%

Moisture Content 96.7%
Heat Content 7,700 BTU/# (DRY)
Ash Content 21.4% (DRY)
Grit Content 9.4% (DRY)
% $\geq$ 1/16" 1.14% (DRY)

Total Coliform 185 x 10^6/100 ml
Fecal Coliform 2 x 10^6/100 ml
Total Plate 43 x 10^6/ml

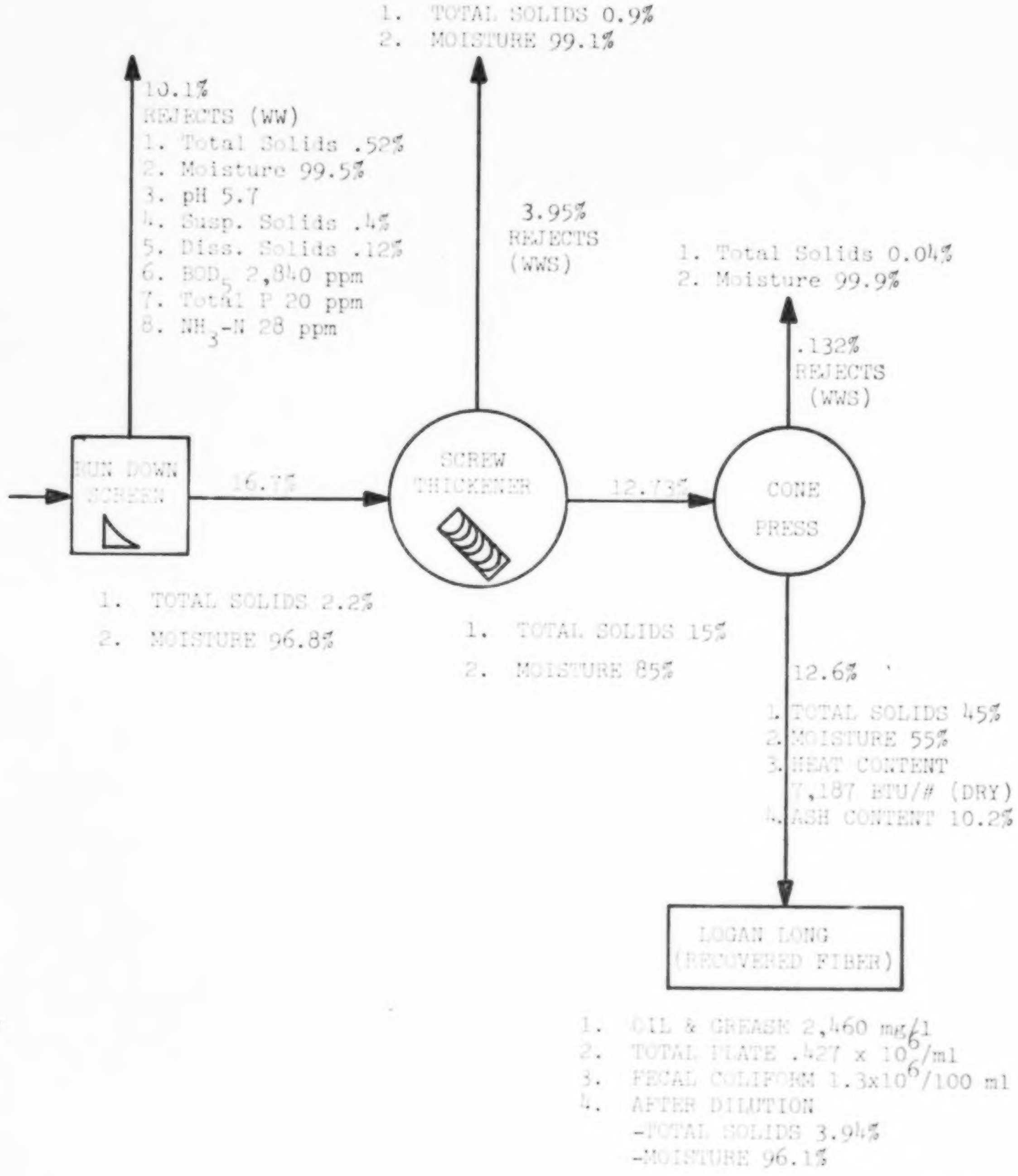

1. TOTAL SOLIDS 0.9%
2. MOISTURE 99.1%
10.1%
REJECTS (WW)
1. Total Solids .52%
2. Moisture 99.5%
3. pH 5.7
4. Susp. Solids .4%
5. Diss. Solids .12%
6. BOD5 2,840 ppm
7. Total P 20 ppm
8. NH3-N 28 ppm
3.95%
REJECTS
(WWS)
1. Total Solids 0.04%
2. Moisture 99.9%
.132%
REJECTS
(WWS)
RUN DOWN
SCREEN
16.7%
SCREW
THICKENER
12.73%
CONE
PRESS
1. TOTAL SOLIDS 2.2%
2. MOISTURE 96.8%
1. TOTAL SOLIDS 15%
2. MOISTURE 85%
12.6%
1. TOTAL SOLIDS 45%
2. MOISTURE 55%
3. HEAT CONTENT
7,187 BTU/# (DRY)
4. ASH CONTENT 10.2%
LOGAN LONG
(RECOVERED FIBER)
1. OIL & GREASE 2,460 mg/l
2. TOTAL PLATE .427 x 10^6/ml
3. FECAL COLIFORM 1.3x10^6/100 ml
4. AFTER DILUTION
-TOTAL SOLIDS 3.94%
-MOISTURE 96.1%

FIGURE 20 - FIBER RECOVERY SYSTEM - STREAM CHARACTERIZATION

This material is made liquid again in the Fiber Dilution Tank and pumped to the Logan Long Company.

5.4.3 Water Requirements for the Fiber Recovery System

As stated in Section 5.4.1, Material Balance Sheet for the Fiber Recovery System, there are two additional inputs to the Fiber Recovery System in addition to the cyclone process stream. These are the process water, and whitewater. The whitewater is used to dilute the cyclone process stream on an as needed basis to reduce the consistency and allow easier processing in the Fiber Recovery System. The use of whitewater varies with the consistency of the whitewater process stream. During the course of our study, the use of whitewater in the Fiber Recovery for dilution purposes has varied from between 102 gallons to 4,700 gallons per ton input to the Fiber Recovery System. The average quantity of whitewater used for dilution purposes is 1,580 gallons per ton input to the system. Figure 21 represents a plot of the total quantity of whitewater used in the Fiber Recovery System. Figure 21 also presents the whitewater used per ton input to the system.

Process water is used in two places in the Fiber Recovery System. The first of these is for elutriation water in the centrifugal cleaners. The second area is for spraying water on the rundown screens. The quantity of process water used in the Fiber Recovery System varies directly with the operating time of that system. As a general rule, no process water is used when the Fiber Recovery System is used in the thickening mode of operation. The amount of process water used per ton of material input to the Fiber Recovery System varies from a minimum of 1,000 gallons to a maximum of 2,370 gallons. The average quantity of process water used per ton input to the system is 1,600 gallons of process water. The process water graphs are given in Figure 22.

5.4.4 Power Requirements for the Fiber Recovery System

Figure 23 presents graphs of total kilowatt hour usage and kilowatt hour usage/ton input to the Fiber Recovery System during the study period. The average kilowatt hours consumed per ton input to the Fiber Recovery System is 21.9. There are no major power usage items in the Fiber Recovery System. The major power usage items in the Fiber Recovery System are as follows:

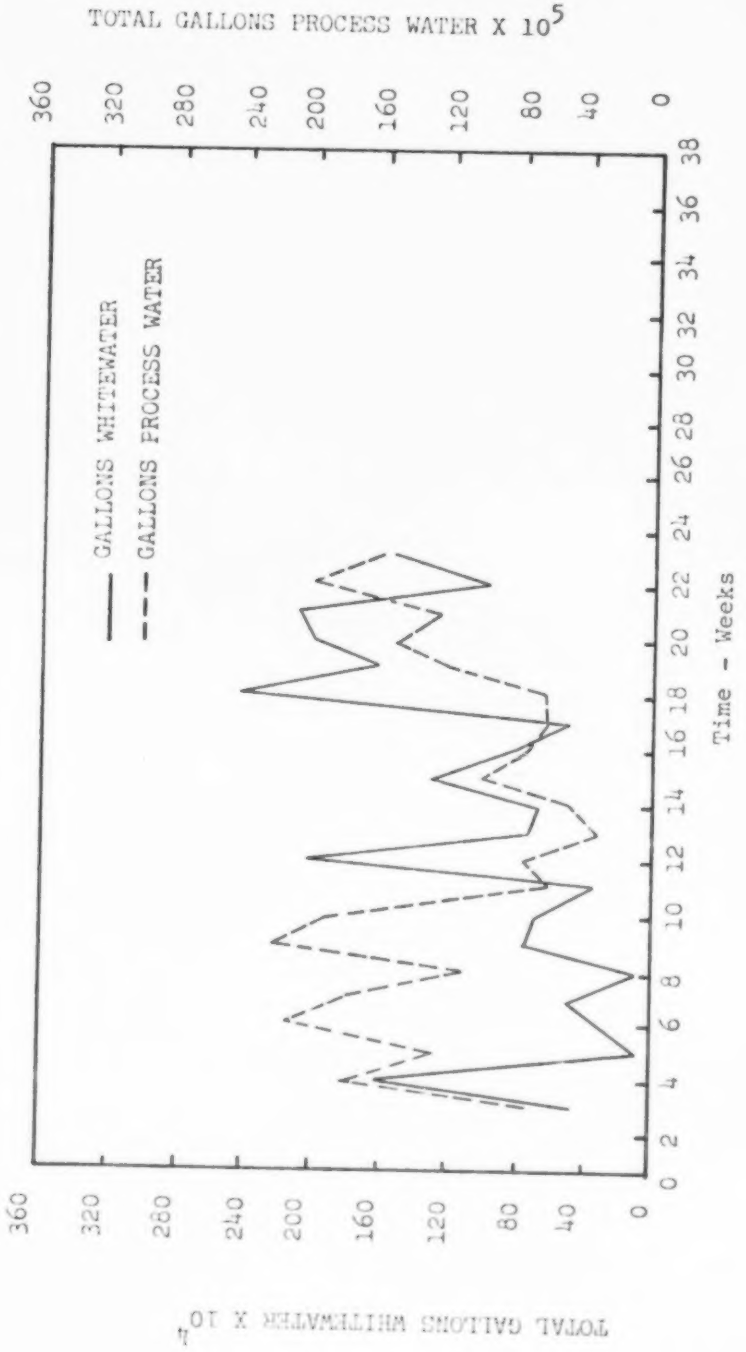


FIGURE 21 - WATER CONSUMPTIONS - FIBER RECOVERY

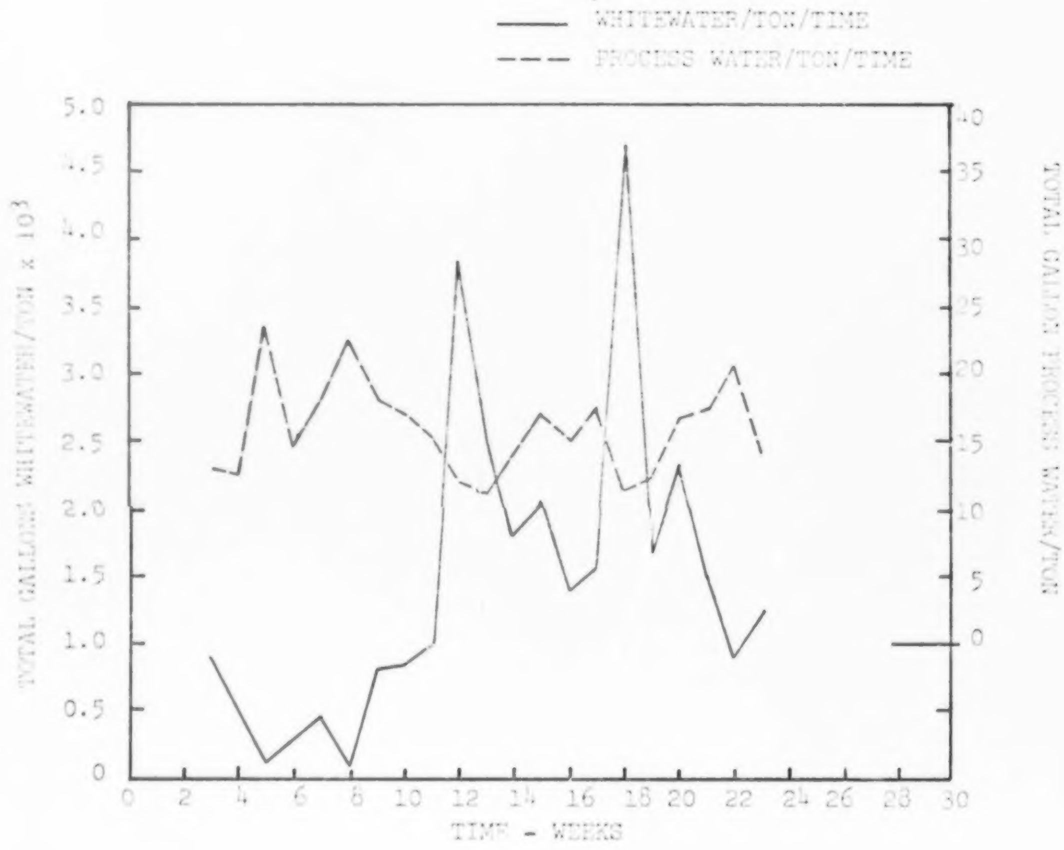


FIGURE 22 - WHITEWATER AND PROCESS WATER CONSUMPTION/TON REFUSE INPUT TO FIBER RECOVERY*

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*Average Weekly Values

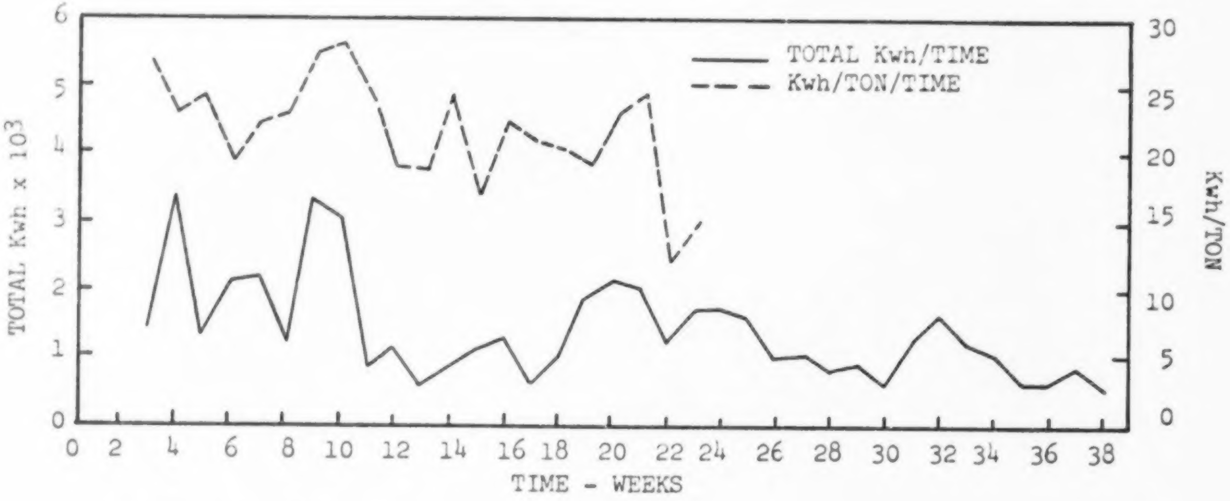


FIGURE 23 - POWER CONSUMPTION DATA/TON REFUSE INPUT TO FIBER RECOVERY

FIBER RECOVERY EQUIPMENT	HORSEPOWER
Selectifier Dilution Tank Agitator	10
Selectifier Dilution Tank Pump	40
Selectifier	100
Cleaner Supply Pump	75
Rejects Tank Pump	25
Stock Sump Pump	15
Whitewater Sump Pump	25
Screw Thickener	10
Cone Press	20
Fiber Dilution Tank Agitator	5
Fiber Pumps to Logan Long	30

As shown the majority of installed horsepower Fiber Recovery System is used in the purification of the fiber. This represents 83% of the 405 horsepower present in the Fiber Recovery System. Sixteen percent of the horsepower used in the Fiber Recovery System is used for the dewatering and the transport of the recovered fiber to the Logan Long Company.

5.4.5 Efficiency of Equipment in the Fiber Recovery System

There are three unit operations on which efficiencies can be determined in the Fiber Recovery System; they are: the selectifier; centrifugal cleaners, and rundown screens.

The selectifier's function is to remove all contaminating materials greater than 1/16 of an inch in diameter. The removal efficiency of the selectifier can be determined by measuring the amount of materials greater than 1/16 of an inch, that are removed by the selectifier. The selectifier input and outputs were analyzed to determine the percentage of material greater than 1/16 of an inch in each stream. The selectifier removal efficiency was found to be 57.4%. This may be considered a low removal efficiency, however, it should be noted that a high quality product is not required.

The centrifugal cleaners are designed to remove the dense gritty material not removed by the liquid cyclone in the P & S subsystem. The efficiency of the centrifugal cleaners was determined by grit analysis. Based on these analyses the centrifugal cleaners have a removal efficiency of 28.6%. Although this removal efficiency is low the glass and grit contamination does not appear to have a great effect on the quality of the fiber. The glass and grit contaminants (durable particulates) affect the strength properties of the fiber only when the size of the durable particulates approach the sheet thickness. The rundown screens are designed to remove the bulk of the "fines" in the centrifugal cleaner process stream. The "fines" detract slightly from the strength properties of the resultant sheet, but do add to the sheet weight and thickness. The rundown screen efficiency for fines removal is 37.9%.

5.5 SUMMARY OF POWER USAGE

During the course of our study, the kilowatt hour consumption was recorded for the hydrapulper, the Fiber Recovery System, and the total plant. The D & I and plant usage was determined by subtracting the kilowatt hours consumed by the hydrapulper in the Fiber Recovery System from the total plant usage. Power data was also obtained for the glass plant but these values were backed out of the data on the following table. Thus, this table represents data for the Franklin plant without the glass plant.

POWER USAGE BY SYSTEM

SYSTEM	AV. K.W. HR/WK.	PERCENT OF TOTAL
1. Total Plant	28,100	100%
2. Pulping & Separation	5,420	19.3%
3. Fiber Recovery	1,410	5.0%
4. Dewatering & Incineration & Plant Usage	21,300	75.8%

In looking at the average kilowatt hours per week and the percent of the total kilowatt hours/week, it can be seen that the Fiber Recovery System only accounted for 5% of the kilowatt hours used. This can be explained in that the Fiber Recovery System only contains 25% of the connected horsepower used in the entire plant and by the fact that the Fiber Recovery System did not operate to the extent that the P & S and D & I subsystem operated. The hydrapulper consumed 19.3% of the total kilowatt hours used in the plant and it represents 18.6% of the connected horsepower on the plant, so this indicates a fairly close correlation between the percent of power used for the percent of connected horsepower. The amounts of power used in the entire plant as well as the percentages can be seen more easily by looking at the pie diagram in Figure 24 as well as the power consumption graphs for the total kilowatt hours, kilowatt hours hydrapulper and kilowatt hours Fiber Recovery System. The tabular data used to plot these figures and obtain percentages of power in the entire plant is included in the Appendix of the report.

Table 6 lists the major electrically operated equipment by system. It also includes all the major power users by subsystem. The total connected horsepower in the plant is 1,617 horsepower. This is composed of 374 horsepower in the P & S subsystem, 838 horsepower in the D & I subsystem and 405 horsepower in the Fiber Recovery System. This represents 23.1, 1.8, and 25% of the horsepower used per system respectively. The major power user in the P & S subsystem is the hydrapulper. This accounts for 85% of the horsepower in that subsystem. The major horsepower requirement in the D & I subsystem is from the fluidizing air blower serving the reactor. This represents 59.7% of the horsepower used in the D & I subsystem or 31% of connected horsepower in the entire plant.

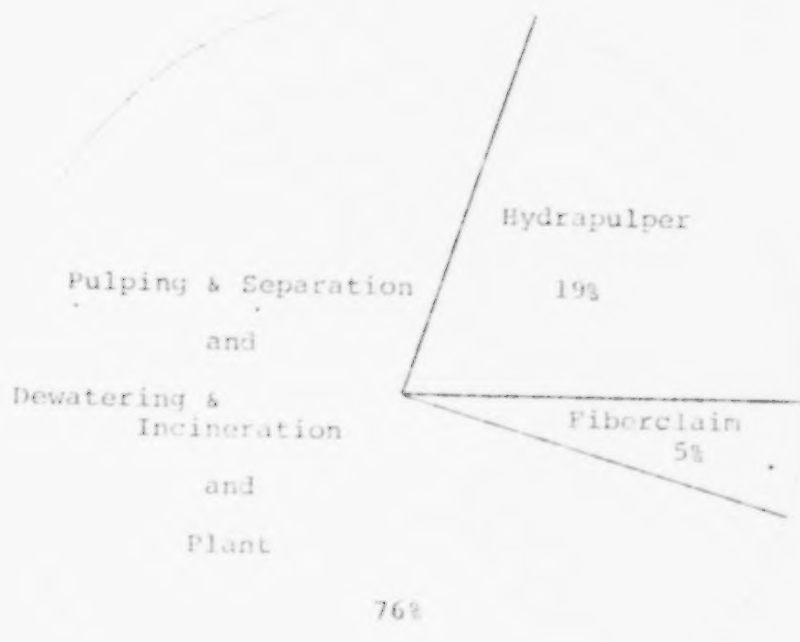
The kilowatt hours per ton used in processing the refuse can be summarized as follows. The average kilowatt hour per ton used by the hydrapulper is 32.5. The average kilowatt per ton input to the Fiber Recovery System is 21.9 kilowatt hours per ton. If the total plant power usages is considered on the basis of a ton input, its value has been determined to be an average of 157 kilowatt hours/ton of refuse which is the input to the P & S subsystem. This figure would not include the unprocessable material which is landfilled.

5.6 SUMMARY OF WATER USAGE

There are three types of water used in the Franklin Solid Waste Plant. These are: whitewater which is used for pulping and transporting refuse materials; process water which is the chlorinated final effluent of the Miami Conservancy Regional Wastewater Treatment Plant, and City water, which is the potable water supply for the City of Franklin.

The whitewater is used to provide pulping and transport media for the refuse and for dilution of the cyclone process stream to achieve easier processing in the Fiber Recovery System.

Process water is used for elutriation water in the cyclones and centrifugal cleaners and for other clean water uses in the plant.



This Figure represents the actual electrical power usage for a nine months period.

The Total Average K.W. Hour/Week = 28,100 kwh.

FIGURE 24 - POWER USAGE IN THE FRANKLIN PLANT

Table 6 -

MAJOR ELECTRICALLY OPERATED EQUIPMENT BY SYSTEM

P&S SUBSYSTEM (23.1%)

Conveyor	10 HP
Hydrapulper	301 HP
Junk Remober	10 HP
Hydrapulper Dump Pump	30 HP
Junk Washer	1 HP
Magnetic Separator	5 HP
Cyclone Recycle Pump	15 HP
Dewatering Screw	2 HP
TOTAL	374 HP

D & I SUBSYSTEM (51.8%

Surge Chest Agitator	50 HP
Surge Chest Pump	25 HP
Berrel Thickeners	45 HP
Screw Conveyor	3 HP
Whitewater Sump Pump	15 HP
Sludge Chest Agitator	20 HP
Sludge Pump	15 HP
Cone Press	80 HP
Sewage Sump Pump	15 HP
Screw Conveyor	3 HP
Rotary Valve	2 HP
Pneumatic Feed	50 HP
Reactor Blower	500 HP
Ash Pump	15 HP
TOTAL	838 HP

FIBER RECOVERY SYSTEM (25.0%)

Selectifier Dilution Tank Agitator	10 HP
Selectifier Dilution Tank Pump	40 HP
Selectifier	150 HP
Cleaners Supply Pump	75 HP
Rejects Tank Pump	25 HP
Stock Sump Pump	15 HP
Whitewater Sump Pump	25 HP
Screw Thickener	10 HP
Cone Press	20 HP
Fibre Dilution Tank Agitation	5 HP
Fibre Pumps to Logan Long	30 HP
TOTAL	405 HP

TOTAL PLANT	1,617 HP

The city water is used in the venturi scrubber serving the fluidized bed reactor.

The areas of water usage in the plant are outlined on Figure 25. This figure shows an area layout of the Franklin Solid Waste Plant.

5.6.1 Whitewater Usage

Whitewater is added to the P & S subsystem by addition to the hydrapulper to make a refuse slurry. The whitewater added to the pulper is done at two places. First, whitewater is added to the junk remover so that a countercurrent flow is established, washing materials ejected from the pulper. Secondly, cyclone recycle water is added via a 4" hose directly into the hydrapulper.

Whitewater is used in the Fiber Recovery System as dilution water in the selectifier dilution tank. These are the only two areas where whitewater is used. The whitewater is recovered from the refuse and recovered fiber slurries in the dewatering phase of the Hydrasposal and Fiber Recovery Systems. Whitewater is also recovered from the rundown screens in the Fiber Recovery System although a considerable portion of this reject stream is pumped to the Miami Conservancy District for treatment.

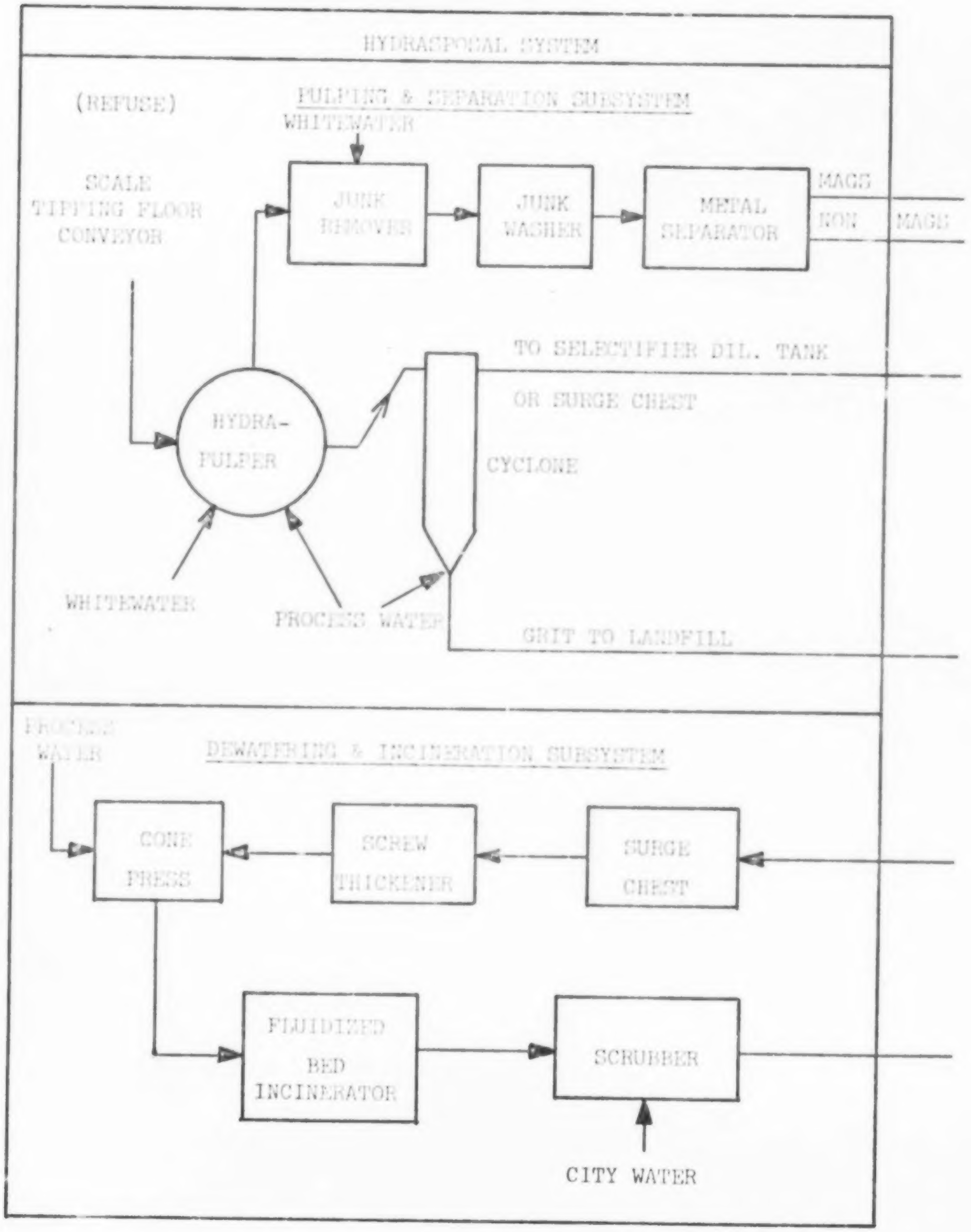
The quantities of whitewater used in the Franklin Plant are plotted on Figure 26. The volume of whitewater used in both Hydrasposal and Fiber Recovery Systems are dependent upon the quantity of material processed and the moisture content of the input tonnage. The whitewater distribution in the plant is given as follows:

	Ave. Gal/Wk.	Percent of Total
Total Whitewater Usage	926,000	100%
Pulping & Separation	815,000	88%
Fiber Recovery System	111,000	12%

The quantities of whitewater used/ton of input material are presented in Figures 27 and 21 for the Hydrasposal and Fiber Recovery Systems respectively. The amount of whitewater used/ton of input averages 4,891 and 1,580 gal/ton for the Hydrasposal and Fiber Recovery Systems respectively.

5.6.2 Process Water Usage

Process water is used in the P & S subsystem for elutriation water in the cyclone and also to cool the oil supply for the hydrapulper motor.


HYDRASPOSAL SYSTEM
(REFUSE)
PULPING & SEPARATION SUBSYSTEM
WHITEWATER
SCALE
TIPPING FLOOR
CONVEYOR
JUNK REMOVER
JUNK WASHER
METAL SEPARATOR
MAGS
NON MAGS
TO SELECTIFIER DIL. TANK
OR SURGE CHEST
HYDRA-PULPER
CYCLONE
WHITEWATER
PROCESS WATER
GRIT TO LANDFILL
PROCESS WATER
DEWATERING & INCINERATION SUBSYSTEM
CONE PRESS
SCREW THICKENER
SURGE CHEST
FLUIDIZED BED INCINERATOR
SCRUBBER
CITY WATER

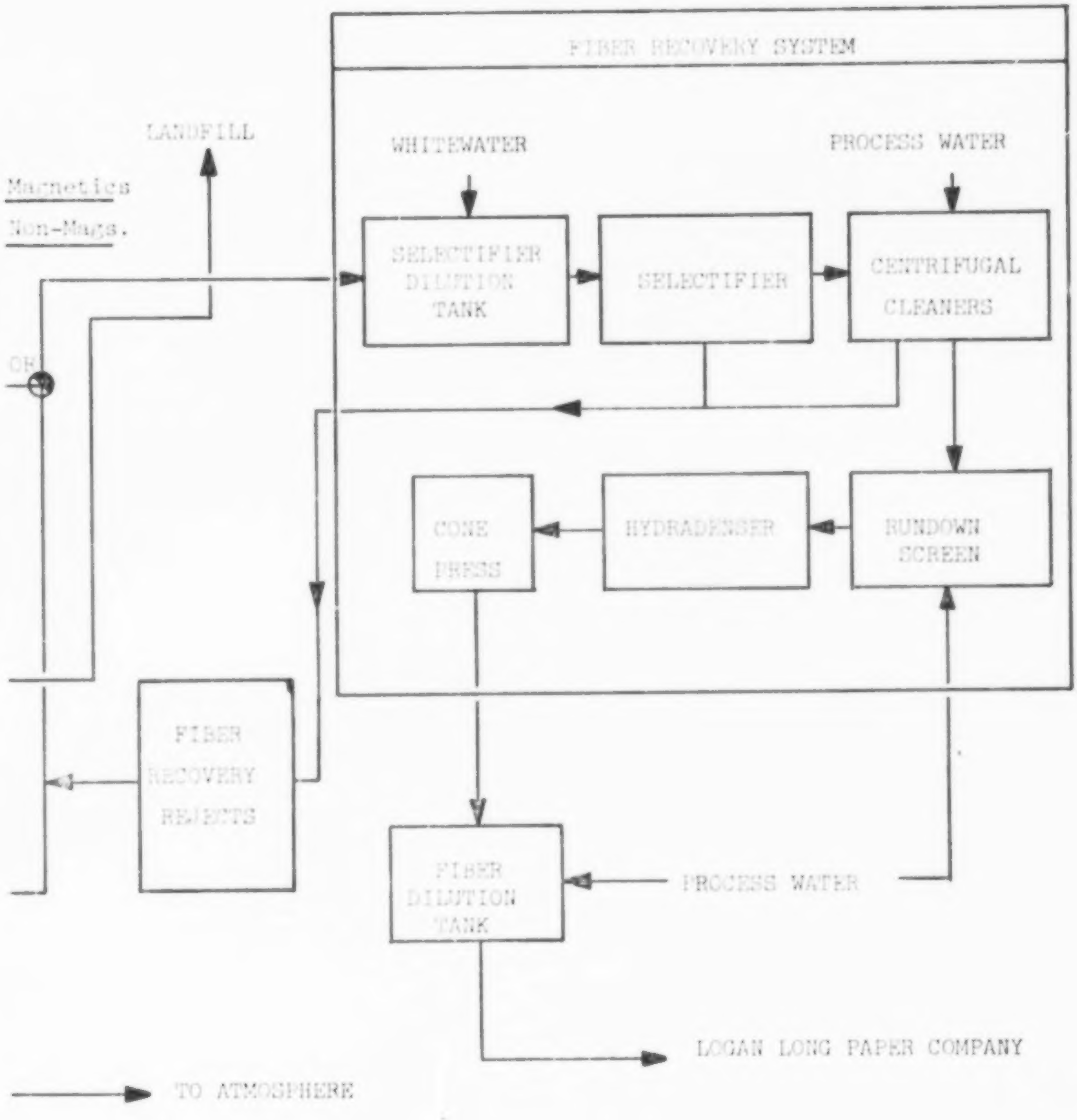
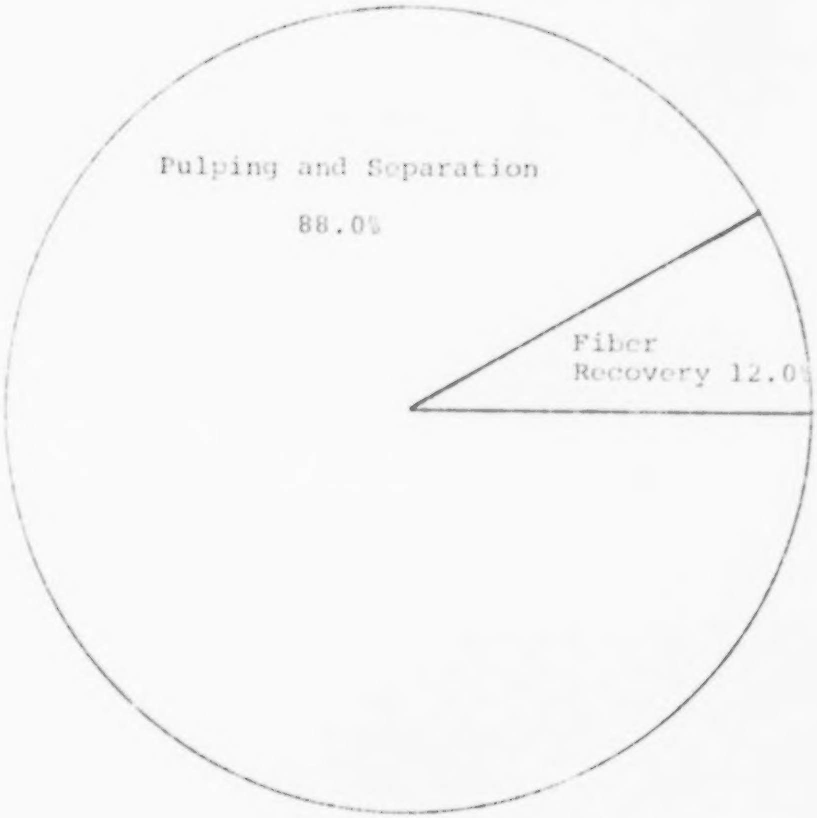

FIBER RECOVERY SYSTEM
LANDFILL
WHITEWATER
PROCESS WATER
Magnetics
Non-Mags.
SELECTIFIER DILUTION TANK
SELECTIFIER
CENTRIFUGAL CLEANERS
OR
CONE PRESS
HYDRADENSER
RUNDOWN SCREEN
FIBER RECOVERY REJECTS
FIBER DILUTION TANK
PROCESS WATER
LOGAN LONG PAPER COMPANY
TO ATMOSPHERE

FIGURE 25 - POINTS OF WHITEWATER AND PROCESS WATER USAGE IN THE FRANKLIN PLANT



This Figure represents the actual Whitewater usage in a six months total.

The Total Average Gallons of Whitewater per week = 926,000 gallons.

FIGURE 26 - WHITEWATER USAGE IN THE FRANKLIN PLANT

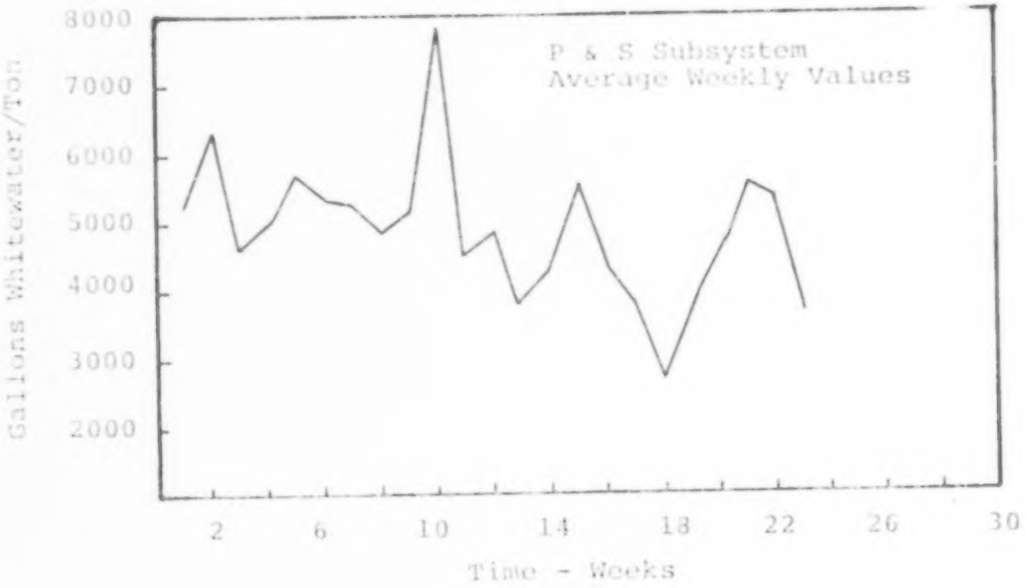


FIGURE 27 - WHITEWATER USAGE PER TON OF REFUSE INPUT TO THE P & S SUBSYSTEM

The process water is used in the Fiber Recovery System as elutriation water in the centrifugal cleaners and for the sprays on the rundown screen. Process water is also used to dilute the recovered fiber before it is pumped to the Logan Long Company.

A negligible amount of process water is used in the D & I subsystem to wash the screen on the cone press. This flow averages 2 gpm which is not significant in the water balance.

The quantities of process water used in the Hydrasposal and Fiber Recovery Systems are presented in Figures 28 and 22. The volumes of process water used in each system is directly dependent on the operating time for that system and the water pressure available from the process water pump. The process water usage in the plant is given as follows:

	Ave. Gal/Wk.	Percent of Total
Total Process Water Usage	405,100	100%
P & S	269,200	66.4%
Fiber Recovery System	125,000	30.8%
Plant Usage	10,900	2.7%

The quantity given for plant usage consists primarily of the amount required for cleaning the plant.

The quantities of process water used/ton of input material are presented in Figures 22 and 20 for the Hydrasposal and Fiber Recovery Systems. The amount of process water used/ton of input averages 1,633 and 1,604 gal/ton respectively.

5.6.3 City Water Usage

City water is used only in the D & 1 subsystem as makeup water for the venturi scrubber. Potable water is not required for scrubber operation but it is used because there is no cost for this water supply. The amount of city water used in the scrubber averaged 2,557 gal/ton input to the D & I subsustem. This data is depicted in Figure 30.

5.7 MAINTENANCE HISTORY DATA

It should be noted that the Franklin Solid Waste and Fiber Recovery Plant is a large pilot operation and represents the first plant of its kind in the world. As such, many equipment modifications and changes would be incorporated in future plant designs. The Franklin Solid Waste Plant, although a pilot operation, has been able to continuously process refuse without interruption.

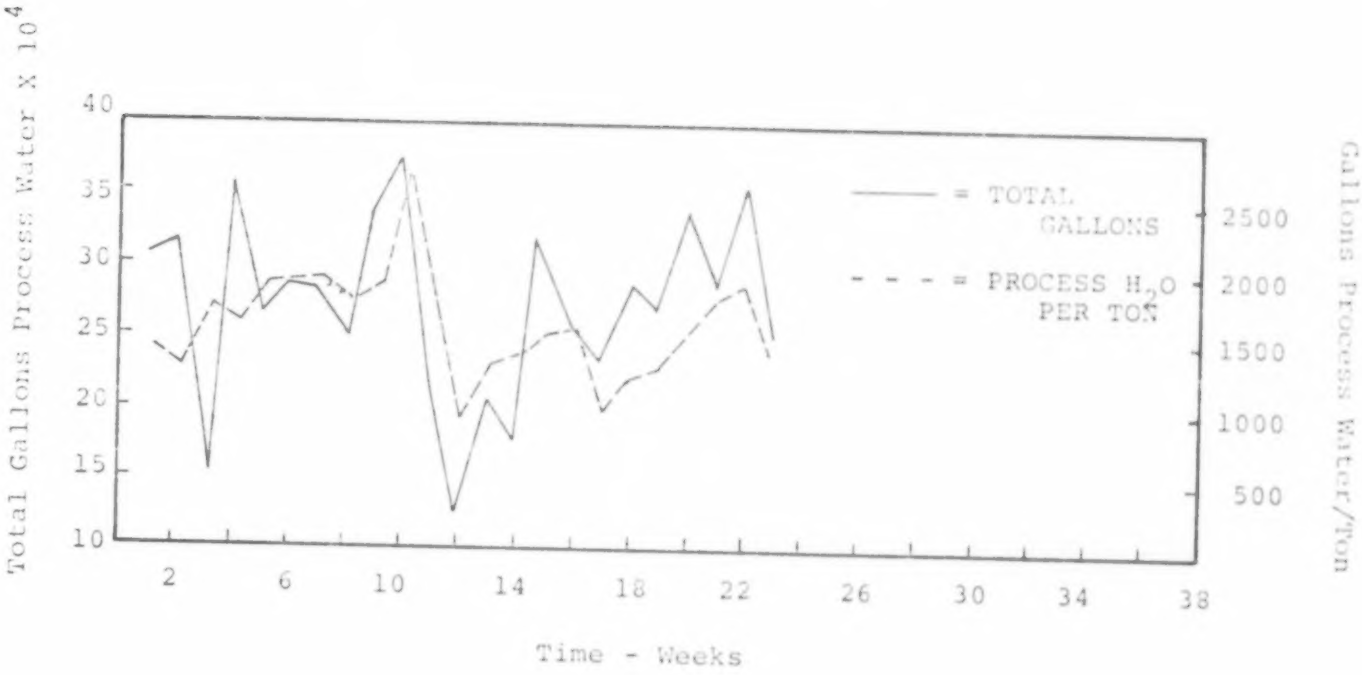
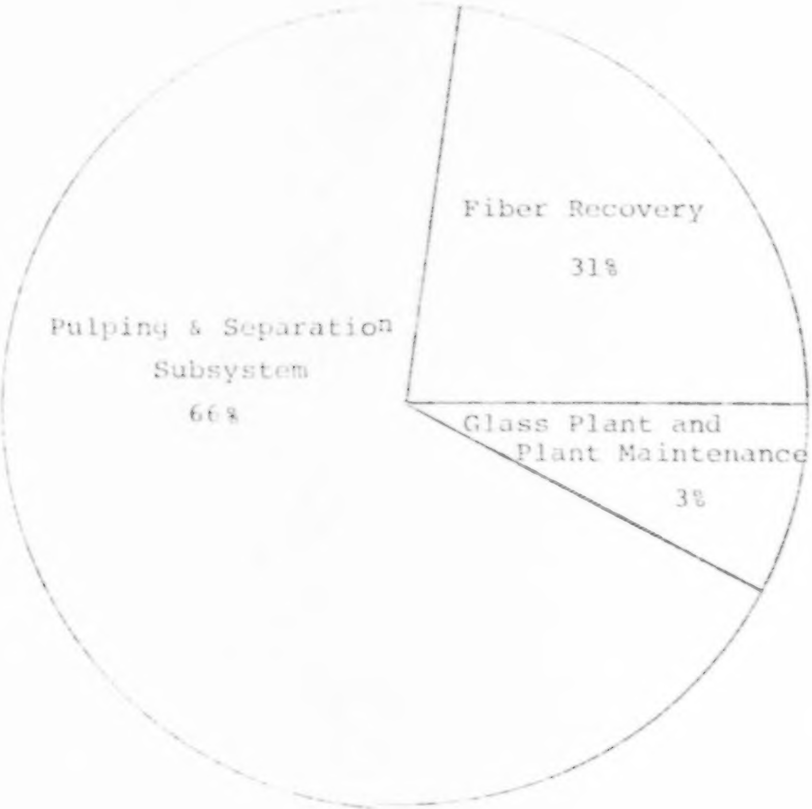


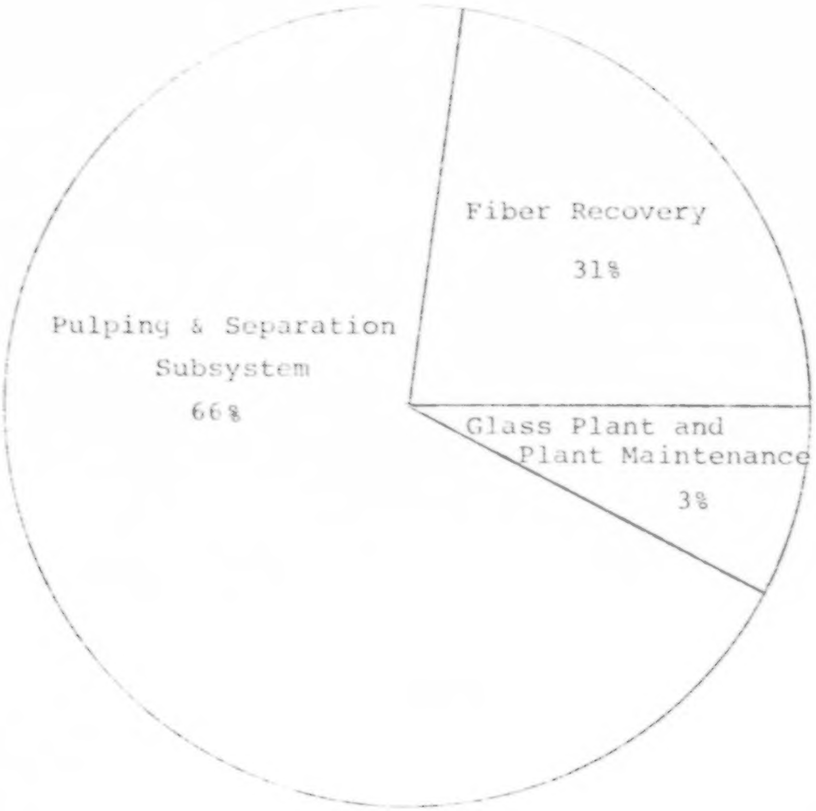
FIGURE 28 - PROCESS WATER PER TON REFUSE INPUT TO P&S SUBSYSTEM



This Figure represents actual process water usage for a 23 week period.

The total gallons of process water/week = 391,000 Gallons

FIGURE 29 - PROCESS WATER USAGE IN THE FRANKLIN PLANT



This Figure represents actual process water usage for a 23 week period.

The total gallons of process water/week = 391,000 Gallons

FIGURE 29 - PROCESS WATER USAGE IN THE FRANKLIN PLANT

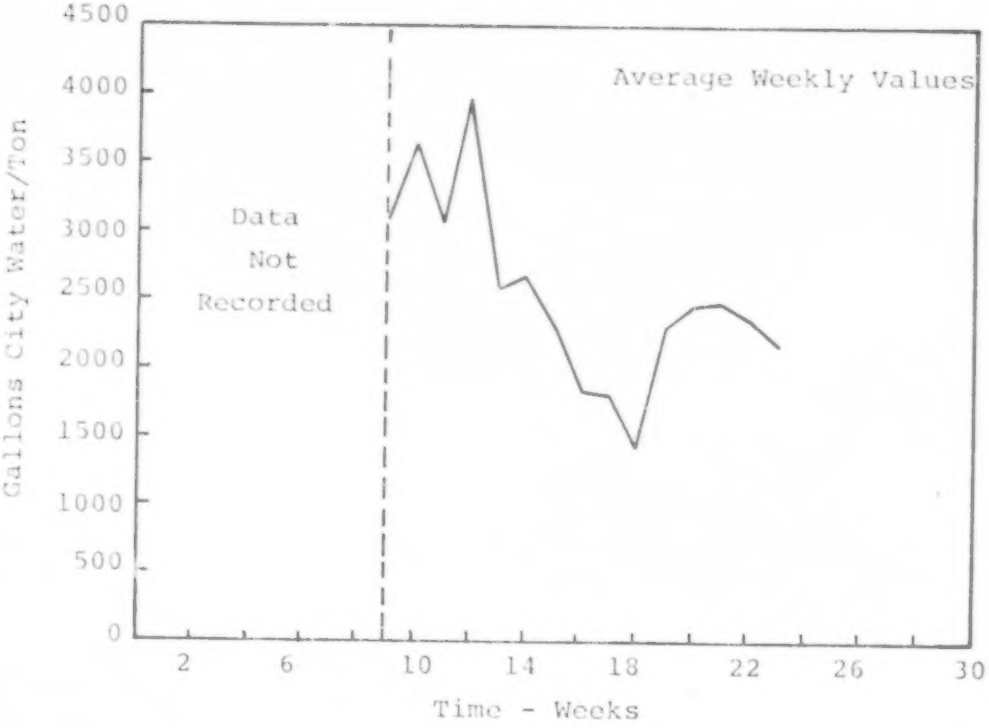


FIGURE 30 - CITY WATER USAGE PER TON INPUT TO THE D&I SUBSYSTEM

The maintenance history for the Franklin Solid Waste Plant is included in the Table 7. The items on this table are arranged in a general flow pattern. The table is arranged by subsystem or system. The repair item is listed on the left, the frequency of occurance, and then the average hours required for repair of that item.

5.7.1 Hydrapulper Maintenance

Problems most often associated with the operation of the hydrapulper are the failure of the stator attaching bolt and the hammer retaining bolts. The rotor is located in the center of the pulper and turns rotating the hammers. The hammers beat against the stator chopping up the refuse. Both the stator and the hammers are involved in pulping the refuse. As a result these parts require more maintenance than other parts within the pulper.

TABLE 7

MAINTENANCE HISTORY FOR FRANKLIN SOLID WASTE PLANT

January 1, 1975 to September 31, 1975

List Maintenance Repair Work	Frequency	Estimated Repair Time in hrs.
PULPING & SEPARATION		
General Pulper Maintenance	4	3.5
Pulper Stator Bolt	10	2
Pulper Motor Bearings	1	2 to 3 days*
Pulper Rotor	5	1.0
Plugging of Whitewater line to Pulper	8	1.5
Dump Pump	5	4.5
Junk Remover Cleaning	10	1.75
Repair of Junk Remover Bucket	6	1.0
Junk Washer	1	
Conveyor carrying Junk Remover P.S.	1	
Cyclone Plugging & Replacement of Cyclone Lining	15	.75
Plugging of Process Water Line to Cyclone	2	.5
Cyclone Recycle Pump	1	
Cyclone rejects dewatering Screw Jammed	3	1.75
Solid Waste Sump Pump #122	1	

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*scheduled maintenance downtime

TABLE 7 (continued)

List Maintenance Repair Work	Frequency	Estimated Repair Time in hrs.
DEWATERING & INCINERATION		
Brushes on the screw thickener motor	1	.5
Thickener basket shearing bolt	1	.75
Rotary Valve	2	8
Clogging of sludge line	3	.5
Press Motor	1	
Pneumatic Blower Motor	1	
FIBER RECOVERY		
Replacement of Whitewater H2O Valve at Selectifier Dilution Tank	1	.5
Selectifier Basket	1	4
Plugging of selectifier reject line	1	.3
Cleaners Feed Pump	1	
Brushes on the screw thickener motor	1	2.5
Recovered Fiber Pump	1	
Whitewater Pump	1	

At least twice a month it was necessary to do general maintenance work on the pulper. This involved cleaning the pulper by removing unwanted tires, wires, and other unpulpable balls which are formed by the action of the pulper. These materials are removed from the pulper by means of an overhead crane and landfilled.

The dump pump removes the refuse slurry from the base plate of the pulper and pumps it to the cyclone. Due to the abrasive nature of this slurry, the impeller on the dump pump is worn out quickly and needs to be replaced often. Another problem which has occasionally occured with the operation of this pump is blockage due to quantities of fiber and rags and plastics. These materials attach themselves to the impeller of the dump pump and reduce the flow to the cyclone. As a result of this, the cyclone does not operate efficiently.

The cyclone has been observed to plug frequently. This results from a piece of wire or a metal strip clogging the grit discharge portion of the cyclone. The second problem associated with the cyclone is the high wear which occurs due to the abrasive character of the glass being removed by the cyclone. This results in the wearing out and tearing of the rubber lining in the cyclone. This causes inefficient operation of the cyclone and as a result the rejects contain a high fiber content and too much grit is contained in the cyclone process stream. This liner problem is close to solution and is mainly a materials problem. One problem with the transport of the cyclone rejects to the glass plant is the overflow of the dewatering screw carrying this material. This screw was not designed to handle the flow from the present cyclone. It has been replaced since the end of the study period with improved results.

The junk remover frequently jams. This is due to the spillage of material off the bucket which accumulates and stops its operation. Additional damage is caused to the system when the blockage shears off buckets from the chain. A second problem with the junk remover is the accumulation of mud and other settable materials in the bottom of the junk remover even with the existing countercurrent flow of whitewater in the junk remover.

5.7.2 The Dewatering and Incineration Subsystem

The rotary valve feeds the cone press process stream into the pneumatic line which carries this material to the reactor. Blockages occur in the feed chute to the rotary valve as a result of the air passing up through the feed chute. Plastics have been blown out on the floor, and because of this the screw conveyor connecting the cone press and the pneumatic feeder has been covered.

Clogging of the sludge line occurred several times during the study. This is the result of a failure of the agitator in the sludge chest. This agitator was extremely difficult to repair because the sludge chest had to be emptied before making repairs. Emptying of the sludge chest was difficult because of the thick nature of the material at the bottom of the chest.

5.7.3 The Fiber Recovery System

One problem which occurred in this system during the course of our study was the failure of the selectifier basket. When this failure occurred all of the subsequent process streams in the Fiber Recovery System became contaminated as did the holding tank and the Logan Long Company. This required four hours to repair and only occurred once during the course of the study.

5.8 RECOVERED MATERIAL CHARACTERIZATION

The major recovered products at the Franklin Resource Recovery Center are magnetic metals, aluminum, glass, and fiber. The discussion which follows includes product marketability, identification, and utilization, of magnetic metal and fiber.

Marketability of these recovered resources is highly variable depending upon quality and market supply and demand. An allied factor modifying marketability is the cost competition of virgin raw material resources which these recovered resource products are supplanting. As the virgin raw materials increase in cost, the recovered resources will gain inroads in these markets. The current economic situation has caused dramatic downward changes in demand and product prices, during the past six months. The data compiled for product prices and demand is based on values obtained largely during the summer months of 1974, which vary widely from the current volatile conditions. Overall, prices and demand for recovered products are very low at this writing. In the following sections identification, marketability and uses for each recovered product are discussed in detail.

5.8.1 Ferrous

The magnetics recovery stream of the Franklin Plant consists primarily of steel cans with smaller fractions consisting of steel wire, bottle tops, bars, sheets, small household appliances, and miscellaneous castings.

Categorization of the input stream of the Franklin Plant has shown that it consists of 9.8% of by weight of magnetic metals. The junk remover and magnetic separator collect 9.6% of the input by weight, and 95.8% of this reject stream is magnetic. Therefore, of all available magnetics contained in the input refuse, 93.8% of these are recovered.

A breakdown of the major categories in the magnetic recovery fraction follows on a percent-by-weight of recovered products basis:

MAGNETIC MATERIALS

Tin Cans	65.0%
Bottle & Jar Caps	2.1%
Metal ends from Paper and Metal Cans	0.4%
Miscellaneous Ferrous	19.2%
Metal Cans with Aluminum Tops	11.4%
Organic Contaminants	1.6%
Nonmagnetic Metals	0.2%

Physical testing of the magnetic materials presented above shows that the recovery stream contains the following:

Moisture	3.9%
Volatile Solids	1.51%
Magnetic Materials	95.8%

Magnetic recovery is accomplished by a magnetic belt positioned above the stream carrying the mixed junks. The product recovered has a high percent of impurities. It is normally bimetallic and impurities in this context are tin, copper, zinc, aluminum, chrome, steels, solder material and coated steel. There is no special classification for this type of iron scrap. Generally, it may be classified as a secondary grade scrap.

Marketability for this scrap grade is variable because of the indefinite classification. Currently, the recovered magnetics are sold on the basis of prorated price for No. 2 bundles, though not classified as No. 2 bundles.

The price for this scrap varies from $13 to $25 per ton when demand is high. This grade of scrap is normally the least desirable of all other available scrap.

Armco Steel Company of Middletown, Ohio, was buying this scrap iron for a price of $15 per ton in the early stages of the Franklin Plant's operation. This scrap was added to and melted with scrap from other sources. Later the Gillerman Iron and Metal Company of St. Louis, MO., began purchasing the scrap for use in its foundries and steel mills.

Because this scrap is high in tin content, it is not steel-making-grade scrap. It can be used in producing reinforcing bars for construction, and to a limited extent, for structural steel. The uses of this scrap are limited because of the impurities. It is used in a small fraction of everything produced in a foundry or steel mill. Conventional furnaces are normally used for melting this material. Removal of impurities would upgrade the product enduse.

5.8.2 Fiber

The Fiber Recovery System of the Franklin Plant was originally designed as an add-on capability for processing, rather than incinerating, the cyclone process stream. The fibrous fraction of the process stream is currently used by the Logan Long Company in the manufacture of asphalt saturated papers. The proximity of the plant and nature of the slurry allow ready transpost via pipeline to the Logan Long Company. The Logan Long Company's normal stock consists of 45% mixed paper, 30% corrugated paper, and 25% newspaper and wood stock. The properties needed in a fiber used for making roofing felt are tensile strength, and absorptivity for kerosene. The corrugated component adds tensile strength; newspaper adds absorptivity. The recovered paper fiber of the Franklin Plant has proven to be a direct substitute for the normal paper stock used by the Logan Long Company.

Marketing the recovered fiber in this instance proved fortunate for both the Franklin Plant and the Logan Long Company. Other markets exist for the fiber as-produced, and within narrow ranges withstanding major equipment modifications, the recovered fiber stream characteristics can be varied. The output of the Recovery System is presently "optimized" for Logan Long's requirements. The recovery efficiency of the Fiber Recovery System is 48.9% of the available fiber in the input.

The recovered fiber was examined for bacterial contamination and other physical parameters. The following data were collected:

1.	Oil and Grease	2460 mg/l
2.	Total Plate Count	427×10^6/ml
3.	Fecal Coliform	1.3×10^6/100 ml
4.	After Dilution in Fiber Chest	Total Solids 3.94% Moisture 96.1%

5.9 MATERIAL BALANCE OF THE FRANKLIN SOLID WASTE PLANT

During the first six months of our study, mass balances were maintained on a daily basis for the entire plant as well as the systems within it. These data were averaged over this time period and are presented in Figure 31 as a material balance diagram. These data represent the actual operating data for this time period.

The average weekly operating time for the P & S subsystem was 24.2 hours. During the same period the operating time for the Fiber Recovery System averaged 16.1 hours. This difference in operating times indicate that the Fiber Recovery System was not operating on a full time basis. The down time in the Fiber Recovery System was largely due to the inability of the customer to receive the recovered fiber. As a result of the down time in the Fiber Recovery System this material balance diagram does not represent the optimum operation of the Franklin Solid Waste Plant. Optimum operation would entail Fiber Recovery operating on a one to one basis with P & S subsystem. This would eliminate the cyclone process stream being diverted to the D & I subsystem for disposal. This change would have an effect on the

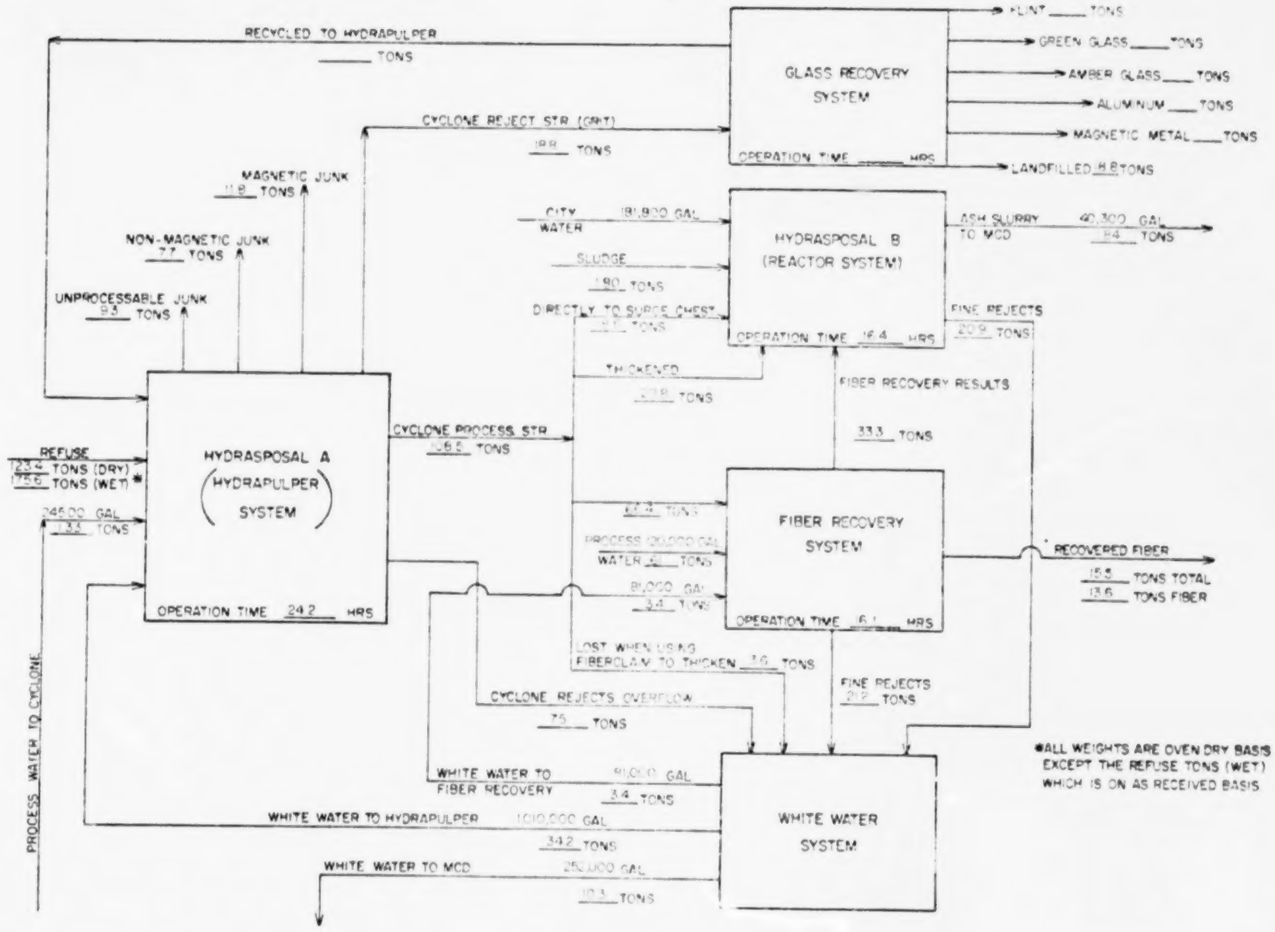

RECYCLED TO HYDRAPULPER
TONS
GLASS RECOVERY SYSTEM
OPERATION TIME HRS
FLINT TONS
GREEN GLASS TONS
AMBER GLASS TONS
ALUMINUM TONS
MAGNETIC METAL TONS
LANDFILLED 11.8 TONS
CYCLONE REJECT STR (GRIT)
18.8 TONS
MAGNETIC JUNK
11.8 TONS
NON-MAGNETIC JUNK
7.7 TONS
UNPROCESSABLE JUNK
9.3 TONS
CITY WATER 181,800 GAL
SLUDGE
19.0 TONS
DIRECTLY TO SURGE CHEST
TONS
HYDRASPOSAL B (REACTOR SYSTEM)
OPERATION TIME 16.4 HRS
ASH SLURRY TO MCD 40,300 GAL
14 TONS
FINE REJECTS
20.9 TONS
THICKENED
TONS
FIBER RECOVERY RESULTS
33.3 TONS
REFUSE
123.4 TONS (DRY)
175.6 TONS (WET) *
24500 GAL
13.3 TONS
HYDRASPOSAL A (HYDRAPULPER SYSTEM)
OPERATION TIME 24.2 HRS
CYCLONE PROCESS STR
106.5 TONS
TONS
PROCESS WATER GAL
WATER TONS
81,000 GAL
3.4 TONS
FIBER RECOVERY SYSTEM
OPERATION TIME 16.1 HRS
RECOVERED FIBER
15.5 TONS TOTAL
13.6 TONS FIBER
LOST WHEN USING FIBERCLAM TO THICKEN TONS
FINE REJECTS
21.2 TONS
CYCLONE REJECTS OVERFLOW
7.5 TONS
WHITE WATER TO FIBER RECOVERY 81,000 GAL
3.4 TONS
WHITE WATER TO HYDRAPULPER 1,010,000 GAL
34.2 TONS
WHITE WATER TO MCD 252,000 GAL
10.3 TONS
WHITE WATER SYSTEM
PROCESS WATER TO CYCLONE
*ALL WEIGHTS ARE OVEN DRY BASIS EXCEPT THE REFUSE TONS (WET) WHICH IS ON AS RECEIVED BASIS

Figure 31 - Material Balance Diagram of the Franklin Plant-Total

amount of recovered fiber as well as the operation of the D & I subsystem. Operation of the Fiber Recovery System full time would mean that all the input to the D & I subsystem would be as rejects from the Fiber Recovery Process.

The operation in the glass plant was intermittant during this period and it could be safely said that when it did operate it was not operating under optimum conditions. As a result, the limited data collected for the glass plant was omitted.

From Figure 31, representing average operating conditions, it can be seen that 7.5% of the dry weight tonnage input to the Franklin Plant is unprocessable material removed on the tipping floor. An additional 15.7% of the input refuse is removed by the junk remover. Of this, 60% is recovered as magnetic materials (9.5% of input refuse). The liquid cyclone removes 15.2% of the input tonnage and directs it to the glass plant the remaining of the input refuse is directed to the Fiber Recovery System when it is operating.

It should be noted that a high percentage (8.3%) of the input refuse is contained in the whitewater which flows to the Miami Conservancy District Regional Wastewater Treatment Plant and received biological treatment the useable fiber which is recovered and pumped to the Logan Long Company represents 12.6% of the input refuse. Of this 11.0% is suspended fiber material. Approximately 40.8% of the input refuse is disposed of in the reactor.

The second material balance diagram(Figure 32)indicates the breakdown of the refuse using a one ton wet weight input. Since the material is on a wet weight basis and our moisture content was 29.4%, the actual dry weight input to the P & S subsystem was .706 tons. This diagram represents optimum operation of the plant in that none of the cyclone process stream is directly disposed of in the D & I subsystem.

The same percentages of material are recovered in the P & S magnetic junk and the same percentages of material are found in the non-magnetic junk and unprocessable material in the input to the system. The only real change which comes with the optimum operation of the plant is the operation of the Fiber Recovery System. It should be noted that the optimum operation of the plant affects the following differences:

1. Increased fiber yield is obtained
2. The amount of whitewater treated in the wastewater treatment plant is increased
3. The input to the D & I Subsystem is reduced, and thus the reactor operation time, and quantities of city water, and ash slurry are reduced.

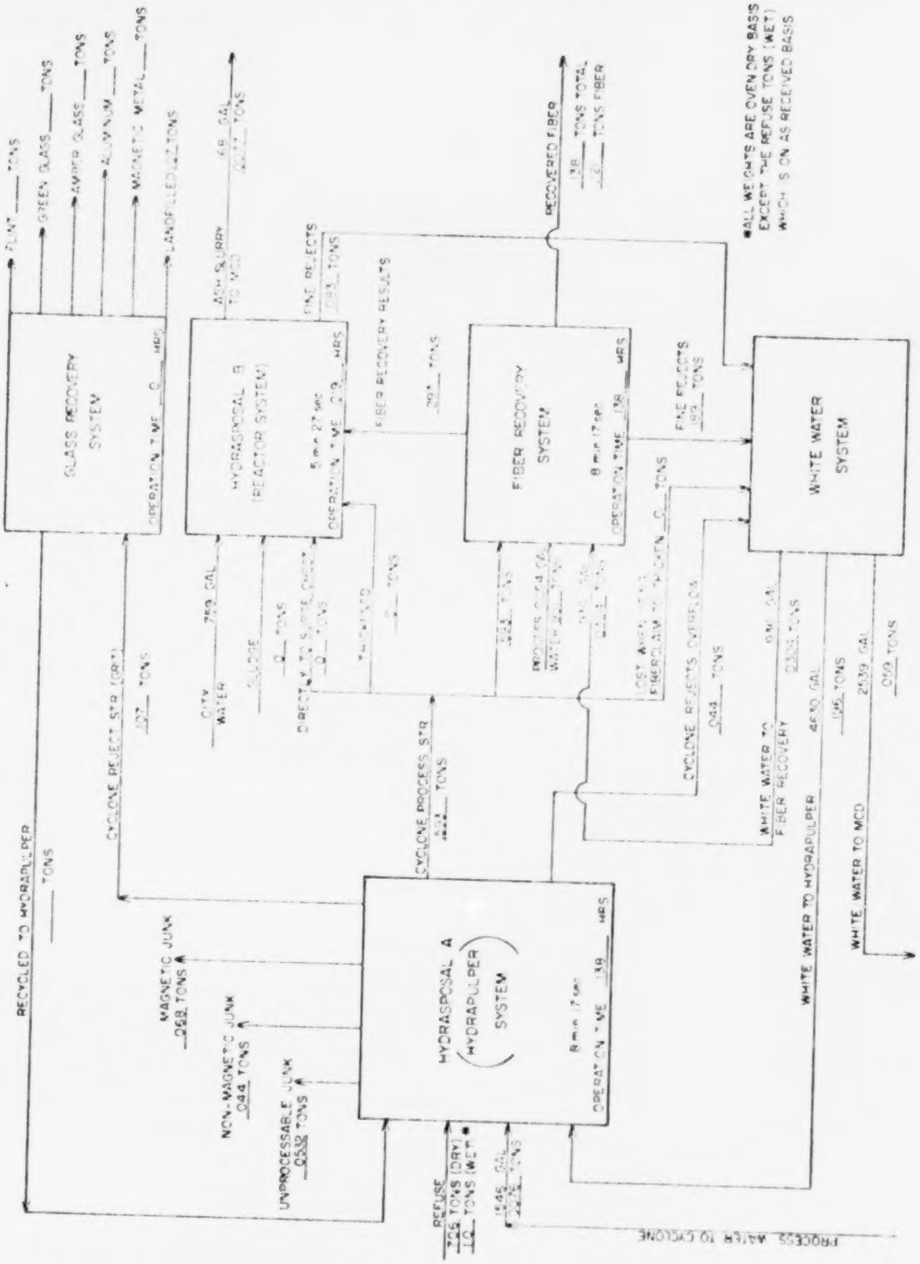

GLASS RECOVERY SYSTEM
OPERATION TIME 0 HRS
FLINT ___ TONS
GREEN GLASS ___ TONS
AMBER GLASS ___ TONS
ALUMINUM ___ TONS
MAGNETIC METAL ___ TONS
LANDFILLED .107 TONS
HYDRASPOSAL B (REACTOR SYSTEM)
5 min 27 sec
OPERATION TIME .219 HRS
ASH SLURRY TO MCD
68 GAL
.0277 TONS
FINE REJECTS .083 TONS
FIBER RECOVERY RESULTS
.291 TONS
FIBER RECOVERY SYSTEM
8 min 17 sec
OPERATION TIME .138 HRS
RECOVERED FIBER
.138 TONS TOTAL
.121 TONS FIBER
*ALL WEIGHTS ARE OVEN DRY BASIS EXCEPT THE REFUSE TONS (WET) WHICH IS ON AS RECEIVED BASIS
FINE REJECTS .193 TONS
WHITE WATER SYSTEM
CYCLONE REJECT STR (GRIT)
.107 TONS
CITY WATER
759 GAL
SLUDGE
0 TONS
DIRECTLY TO SURGE CHEST
0 TONS
THICKENED
0 TONS
PROCESS WATER
LOST AMERICAN FIBERCLAIM TO THICKEN 0 TONS
CYCLONE REJECTS OVERFLOW
.044 TONS
WHITE WATER TO FIBER RECOVERY
4690 GAL
1.96 TONS
2539 GAL
.059 TONS
CYCLONE PROCESS STR
TONS
RECYCLED TO HYDRAPULPER
___ TONS
MAGNETIC JUNK
.068 TONS
NON-MAGNETIC JUNK
.044 TONS
UNPROCESSABLE JUNK
.0532 TONS
HYDRASPOSAL A (HYDRAPULPER SYSTEM)
8 min 17 sec
OPERATION TIME .138 HRS
REFUSE
.706 TONS (DRY)
1.0 TONS (WET)*
1546 GAL
TONS
WHITE WATER TO HYDRAPULPER
WHITE WATER TO MCD
PROCESS WATER TO CYCLONE

Figure 32 - Material Balance Diagram
Of the Franklin Plant-One Ton Input

As is evident from this diagram the Fluid Bed Reactor only operates 65% of the operating time of the other two systems. This is because of: 1) the recovery and disposal of materials which do not require input to the reactor and 2) the higher dewatering and incineration capacity of the D & I subsystem.

5.10 HEAT AND ASH CONTENT DATA

The heat values of the recovered products and individual streams within the Franklin Plant are of interest from the standpoint of using these materials as a possible fuel source and in determining a heat balance within the plant. For this reason the heat contents of individual streams have been determined using standard bomb calorimetry techniques. The heat contents are reported on both an oven dry basis and a wet basis. All reported heat contents are the "higher heating values" or gross heats of combustion because the heat from condensation of the water vapor resulting from the combustion of hydrogen in the samples is included. The following table presents average heat contents for the streams listed. The ash and moisture contents are included for comparison.

Process Stream	Moisture %	Heat Content Dry Basis BTU/#	Heat Content Wet Basis BTU/#	Ash * Content %
Surge Chest P.S.	97.3	7383	- 807	22.3
Sludge	91.4	7636	- 241	44.7
Cyclone P.S.	97.0	7221	- 785	23.4
Cyclone R.S.	11.1	417	252.7	93.6
Fiber Recovery Press P.S.	59.1	7187	+2337	10.2
D & I Press Process Stream	51.8	8600	+3600	24.5

The D & I Press Process Stream has a relatively high heat value. This is due to a lower moisture content and thus a lower concentration of dissolved (noncombustible) salts,

The laboratory procedure used in determining the ash content listed in the above table was the procedure outlined in the "Thirteenth Edition of Standard Methods for the Examination of Water and Wastewater." This procedure specifies test conditions of 550^{o} C for a time period long enough to obtain a constant weight. This procedure is not universally followed for ash determinations of fuels. As a result of the absence of a uniform test procedure the above values could appear to be high for processed solid waste due to variations in test methods.

---

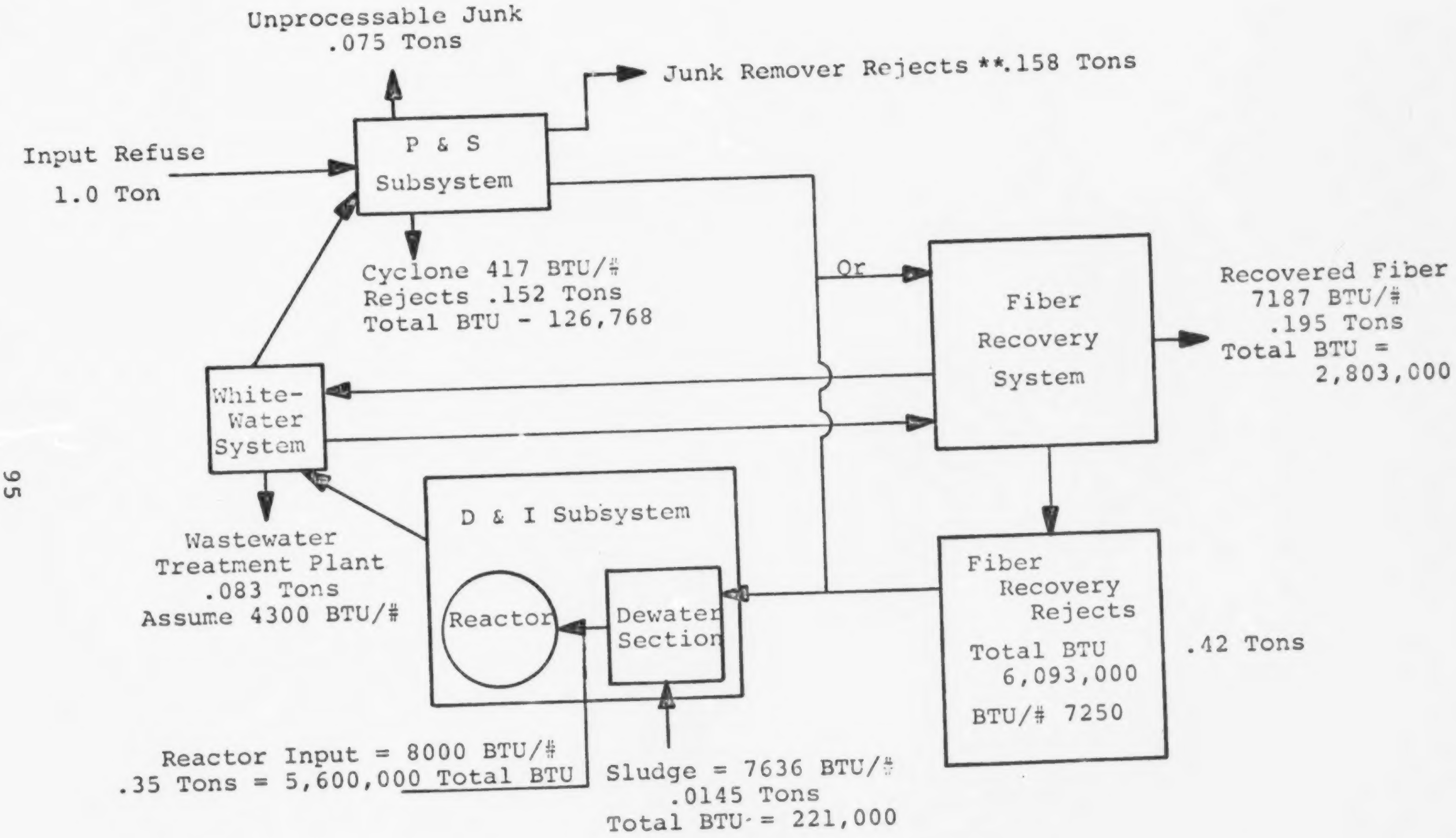
*The ash content data is given on a dry weight basis.

Analysis were conducted to determine the variation in ash contents with variation in test condition the following results were obtained by analysis of the same sample of cone press process stream at different test conditions.

SAMPLE	TEMPERATURE	TIME	% ASH
1	600°C	20 min	18.1%
2	800°C	30 min	14.5%
3	950°C	45 min	10.8%

It is obvious from these results that a decrease in ash content occurs with increasing temp and time of heating. This table offers an explanation of apparent variations in ash contents which have been reported by other investigators. Figure 33 represents a heat balance for the Franklin Solid Waste Plant. This figure will give rough idea as to the distribution of total heat value within the plant. Assuming that the unprocessable junk and the junk remover rejects have no significant heating value then the heat content of the input refuse can be calculated from the sum of the heat values given for the cyclone process stream and the input refuse based on these values the heat content of the input refuse is 9,022,000 BTU/Ton or 4,5111 BTU/#. The outputs from the P & S subsystem, the cyclone rejects and the cyclone process stream, contain 126,768 BTU/T processed and 8,896,000 BTU/T processed respectively. The cyclone rejects contains only 1.5% of the heat content of the input refuse. This low heat value is to be expected because the purpose of this unit operation is to remove inert materials. Indeed this verifies that most of the material in this stream is inert matter and not combustible material. The total amount of material realistically available for energy use is contained in the cyclone process stream. On a practical basis, the cyclone rejects would not be used as a source of heat because of their low heat value and high ash contant.

If the Fiber Recovery System is operating, the amount of fiber recovered per ton of refuse input is .195 tons. This recovered fiber has a BTU content of 7200 BTU/lb which is equivalent to a heat output of 2,830,000 BTU/T processed. If the Fiber Recovery System operates the total BTU input to the D & I subsystem is 6.314,000 BTU/T processed. In the operation of the Fiber Recovery System approximately 31% of the available heat energy is removed in the recovered fiber. It should be noted that .083 tons or 8.3% of the input tonnage to the system has contained in the whitewater flows to the Miami Conservancy Treatment Plant. The BTU lost in these ,083 tons per ton processed is approximately 714,000 BTU/T processed.


Unprocessable Junk
.075 Tons
Junk Remover Rejects **.158 Tons
Input Refuse
1.0 Ton
P & S
Subsystem
Cyclone 417 BTU/#
Rejects .152 Tons
Total BTU - 126,768
Or
Fiber
Recovery
System
Recovered Fiber
7187 BTU/#
.195 Tons
Total BTU =
2,803,000
White-
Water
System
Wastewater
Treatment Plant
.083 Tons
Assume 4300 BTU/#
D & I Subsystem
Reactor
Dewater
Section
Fiber
Recovery
Rejects
Total BTU
6,093,000
BTU/# 7250
.42 Tons
Reactor Input = 8000 BTU/#
.35 Tons = 5,600,000 Total BTU
Sludge = 7636 BTU/#
.0145 Tons
Total BTU = 221,000

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*Dry Weight Basis/**Assume No Significant Heating Value

FIGURE 33 - HEAT BALANCE DIAGRAM*

6.0 RESULTS OF ENVIRONMENTAL EVALUATION OF THE FRANKLIN SOLID WASTE PLANT

6.1 INTRODUCTION

The major impact of the Franklin Solid Waste and Fiber Recovery Plant is the beneficial effect that it produces by reducing the land disposal of solid waste stream and a sewage sludge stream and by the recovery of valuable resources. This of course must be weighed against the environmental impact of the various streams resulting from the operation of the plant.

The environmental impact of the Franklin Solid Waste and Fiber Recovery Plant on air quality can best be characterized by the evaluation of the gaseous emissions from the fluidized bed incinerator. Three tests have been conducted previously on this unit. Section 5.2 will discuss these tests results.

The environmental impact of this plant with respect to water quality can be best accomplished by characterizing the influent and effluent flows to the solid waste plant. There are two influent flows; 1) the City water which is used in the operation of the scrubber and 2) the chlorinated effluent from the Miami Conservancy Regional Wastewater Treatment Plant. There are three effluent flows from the Solid Waste and Fiber Recovery Plant. These are: 1) the ash slurry which is the scrubber effluent from the venturi scrubber serving the fluidized bed reactor; 2) whitewater from the fiber recovery operation; 3) whitewater which is the expressed liquid from the thickener process stream removed in the cone press.

Finally an occupational safety and health evaluation was conducted with respect to industrial hygiene and noise and the results are presented in Sections 5.6,5.7, and 5.8.

6.2 ENVIRONMENTAL IMPACT ON AIR QUALITY

The effect on air quality from the Franklin Solid Waste and Fiber Recovery Plant can be determined by evaluating the emissions from the fluidized bed incinerator. Three exhaust gas emission tests were conducted by Environmental Sciences, Inc. The tests were conducted from December 28, 1971, to January 1, 1972.

Although three tests were conducted, compliance determinations can be made only on the basis of the last two tests. This is because no feed rate to the incinerator was determined in the first emissions tests, and compliance determinations are made on the basis of feed rate. The Federal Standard for particulate matter which applies to new source performance standards for incinerators states..."that no owner or operator ... shall discharge or cause the discharge into the atmosphere of particulate matter which is in excess of 0.08 grains per standard cubic foot (0.18 grams/NM^3) corrected to 12 percent CO_2 maximum two hour average". The Federal Regulation also states that, "all performance tests shall be conducted while the affected facility is operating at or above the maximum refuse charging rate at which such facility will be operated, and the solid waste burned shall be representative of normal operation and under such relavant conditions as the administrator shall specify".

The Ohio Standards, which are more strict than the Federal Standards, specify an emission rate of not more than 0.10 pounds particulate emission for every 100 pounds of material incinerated. The Environmental Sciences report indicated a feed rate of 80 pounds per minute or 4800 pounds per hour. Therefore, the allowable emission rate for the fluidized bed incinerator is 4.80 pounds per hour. The calculated particulate rate from the second and third emissions tests are 6.90 and 4.70 pounds of particulate per hour. However, the calculated particulate emission rate which includes the condensable portion of the particulate matter is no longer included in the emission rate for compliance determinations for the Federal or State regulations. Therefore, the dry particulate rate of 3.31 and 2.75 pounds per hour should be used for compliance determination. Based on these emission rates the emissions from the fluidized bed incinerator do comply with current Ohio Air Pollution control regulations.

For comparison with the Federal Standards, the particulate emission rate is given in concentration values corrected to 12 percent CO_2, According to the Environmental Sciences data the percent by volume of CO_2 on test 2 and 3 averaged 8.5% on a dry gas basis. This value is used to correct to 12 percent CO_2. The correction is as follows:

The particulate concentration at 12 percent CO_2 =

$$\frac{(0.043\ \text{GR/SDCF})\ (12\%\ CO_2)}{8.5\%\ CO_2} = .0607\ \text{GR/SDCF}$$

Since the particulate emission rate of .0607 grains per standard dry cubic foot is less than 0.08 grains per standard cubic foot the emissions from the fluidized bed incinerator appear to meet the new source performance standards for incinerators.

Although the emissions from the incinerator appear to meet all applicable standards, it should be noted that the tests were not conducted at maximum rated capacity of the incinerator and the test methods outlined both in the Federal Register and the Ohio Air Pollution Control codes were not followed in obtaining the sample. Specifically, both Federal and State regulations require the test to be conducted at the maximum burning rate of the incinerator. These tests were conducted at the normal operating rate of the incinerator. Also, both Federal and State stationary source testing procedures for particulate matter on circular ducts specify that two sample ports shall be used. Only one sample port was used downstream from the venturi scrubber. This would not correspond to either Federal or State regulations. The isokinetic ratios for the samples collected on test number 2 and 3 on the outlet to the venturi scrubber are within acceptable present day standards that the compliance with existing standards would be achieved on the emission rate.

6.3 ENVIRONMENTAL IMPACT ON WATER QUALITY

The impact on water quality can be assessed by evaluating the influent and effluent flows from the solid waste plant. Liquid inputs to the solid waste plant consist mainly of process water and city water. The process water is obtained from the chlorinated final effluent of the Miami Conservancy Wastewater Treatment Plant. City water is obtained from the municipal water supply for the City of Franklin. A third input is the moisture contained in the input refuse and sewage sludge.

There are three outputs from the solid waste plant which flow to the adjacent sewage treatment plant, and one liquid output (with recovered fiber) that is pumped to the Logan Long Company. The streams to the wastewater treatment plant consist of; the flows from the sewage sump in the D & I subsystem; The ash slurry from the venturi scrubber; and the flow from the whitewater sump in the fiber recovery system. The primary characteristics of each stream are contained in the following tables.

From the following table it is seen that the ash slurry consists largely of biologically inert, well-oxidized, suspended and dissolved solids.

This output stream (ash slurry) is not affected by biological treatment except for nutrient (NH_3-N, PO_4) utilization. It does not require biological treatment and only sedimentation or primary treatment for suspended solids removal is needed.

The sewage sump receives the expressed liquid from the cone press. This liquid contains a liquid portion of the sludge as well as the liquid portion of the barrel thickener

Table 8 - ASH SLURRY

Parameter	Units	Average Value
Flow	MGD	0.01
Water Temp.	Cent.	31.00
PH FLD		5.40
Turbidity Lab	JTU	2841.36
Conductivity Lab	MICRO-MHO	2424.50
PH Lab		8.28
Alkalinity	MG/L	357.53
Hardness	MG/L	957.84
Chlorides	MG/L	526.25
Sulfates	MG/L	662.15
Total Solids	MG/L	8430.46
Dissolved Solids	MG/L	2826.46
Suspended Solids	MG/L	5453.15
Ammonia Nitrogen	MG/L	3.03
Nitrate Nitrogen	MG/L	3.23
TOT PHOSPHORUS	MG/L	27.42
C-BOD2	MG/L	7.90
C-BOD5	MG/L	18.22
C-BOD7	MG/L	22.62
C-BOD10	MG/L	27.60
C-BOD15	MG/L	37.62
C-BOD20	MG/L	45.37
TOC	MG/L	66.84
COD	MG/L	356.84

TABLE 9 - SEWAGE SUMP

Parameter	Units	Average Value
Flow	MGD	0.0420
Water Temp.	Cent.	13.33
PH FLD		4.80
Dissolved Oxygen	mg/l	4.00
Turbidity Lab	JTU	1819.09
Conductivity Lab	MICRO-MHO	2777.63
PH LAB		5.68
Alkalinity	mg/l	422.18
Hardness	mg/l	950.18
Chlorides	mg/l	356.63
Sulfates	mg/l	477.50
Total Solids	mg/l	7214.54
Dissolved Solids	mg/l	3224.45
Suspended Solids	mg/l	2882.00
Ammonia Nitrogen	mg/l	27.40
Nitrate Nitrogen	mg/l	0.68
Tot Phosphorus	mg/l	22.18
C-BOD2	mg/l	1261.20
C-BOD5	mg/l	2660.00
C-BOD7	mg/l	2907.55
C-BOD10	mg/l	3239.66
C-BOD15	mg/l	3843.88
C-BOD20	mg/l	4189.00
TOC	mg/l	1351.81
COD	mg/l	6798.90

process stream. This stream is similar to the stream obtained from the whitewater sump in the fiber recovery system. This is understandable because the majority of the liquid being removed from the barrel thickener process stream consists of the whitewater in the refuse slurry. One difference between these two streams is that the whitewater sump which contains the water passing through the slotted rundown screen is higher in suspended solids. The opening on these screens are .020 inch and as a result the suspended solids is approximately 1.7 greater than that ound in the sewage sump. Since both the sewage sump flow and the flow from the whitewater sump contain quite a large amount of whitewater, the characteristics given in Table for the whitewater could be applied to both these flows. Both the streams from the sewage and whitewater sumps could be considered to be the equivalent of concentrated industrial waste streams. Although their combined flows average 157,000 gallons per day, the BOD_5 loading is 3,665 pounds of BOD_5 per day, representing a population equivalent of 21,600 people. Combined suspended solid loading from the sewage and whitewater sumps average 5,623 pounds suspended solids per day. Nutrient concentrations in these effluent streams are not much higher than the normal range expected for domestic wastewater.

It should be noted that in considering the amounts of material from each stream that the fiber recovery stream contributed 81 percent of the suspended solids and 73 percent of the BOD of the streams effluent from the plant.

The two waste streams from the plant which require treatment contain moderate amounts of heavy metals. In a conventional wastewater treatment plant these concentrations of heavy metals would not greatly effect biological treatment processes if sufficient dilution were provided in the wastewater treatment plant. Even if these two waste streams made up the major flow to a small treatment facility, there is a strong possibility that the bacteria in the secondary treatment processes would become acclimated to the metal contents in the streams. Composite samples were taken from the whitewater system, a fraction of which flows to the Miami Conservancy Wastewater Treatment Plant. The average analysis results from these collected samples are given in the following table.

It should be noted that the analysis performed on the streams from the solid waste plant are for total metals, and would include the suspended as well as the dissolved materials. Even so, these values are higher than those encountered in normal domestic wastewater.

TABLE 10 - WHITEWATER SUMP

Parameter	Units	Average Value
Flow	MGD	0.11
Water Temp.	Cent.	28.60
Dissolved Oxygen	mg/l	7.60
Turbidity Lab	JTU	2436.89
Conductivity Lab	MICRO-MHO	2398.04
PH Lab		5.78
Alkalinity	mg/l	334.27
Hardness	mg/l	730.18
Chlorides	mg/l	343.04
Sulfates	mg/l	273.54
Total Solids	mg/l	7195.91
Dissolved Solids	mg/l	2822.90
Suspended Solids	mg/l	4795.00
Ammonia Nitrogen	mg/l	28.85
Nitrate Nitrogen	mg/l	0.45
TOT Phosphorus	mg/l	20.01
C-BOD2	mg/l	1556.78
C-BOD5	mg/l	2840.00
C-BOD7	mg/l	3525.42
C-BOD10	mg/l	3948.21
C-BOD15	mg/l	4608.26
C-BOD20	mg/l	5123.20
TOC	mg/l	2271.94
COD	mg/l	8954.30

TABLE 11 WHITEWATER CHARACTERISTICS VS DOMESTIC SEWAGE

METAL METAL	AVERAGE CONCENTRATION WHITEWATER SYSTEM	AVERAGE CONCENTRATION NORMAL DOMESTIC SEWAGE
Cadmium	92.5 µg/l	40 µg/l
Manganese	495.0 µg/l	200 µg/l
Zinc	557.0 µg/l	1.0 mg/l
Nickel	3,990.0 µg/l	250.0 µg/l
Iron	3,990.0 µg/l	
Lead	6,225.0 µg/l	300.0 µg/l
Tin	190.0 µg/l	
Chromium	700.0 µg/l	250.0 µg/l
Copper	11.4 mg/l	200.0 µg/l

The metal concentrations in the Whitewater system were very high compared to normal domestic sewage. The heavy metal concentrations in the Whitewater system are compared with those expected in normal domestic sewage in Table 11 above. It should be noted that the analyses performed on the streams from the solid waste plant are for total metals, and would include the suspended as well as the dissolved materials. Even so, these values are approximately twice as high as those encountered in normal domestic wastewater. This water is sent to the MCD for treatment and further removal following effluent stream analysis.

6.4 CLOSED LOOP OPERATION

The Franklin Solid Waste Plant operates in conjuction with the wastewater treatment plant by exchanging large volumes of process water, whitewater, and ash slurry water, and by accepting sewage sludge for final disposal. To test the feasibility of operating a solid waste plant independently of the wastewater treatment plant, a closed loop test was conducted at the Franklin Solid Waste Plant from Tuesday, October 30, to Friday, November 16, 1973. These tests were conducted to demonstrate the effects of total water recycle in the operation of the Hydrasposal system and to provide operating data which more closely approximated the conditions planned for the Hempstead, Long Island, Solid Waste Plant. Special attention was given to suspended and dissolved solids, pH, acidity, and temperature conditions in the whitewater system and to the dewatering efficiency of the thickener and cone press at higher solids concentrations. The test conditions involved processing refuse at a high rate for five day period separated by two days downtime, (10 day test). The Fiber Recovery System was shut down throughout the test period and no sludge was disposed of in The Dewatering and Incineration Subsystem. No water was sent to the wastewater treatment plant. The only water input to the solid waste plant was contained in the moisture content of the refuse and makeup water which was added at the operators discretion to the whitewater chest. The output of water from this system was the fluidized bed reactor.

The water obtained from the dewatering of the cyclone process stream in the D&I subsystem was used for dilution water in the hydrapulper during the closed loop operation. A portion of the liquid expressed in the cone press was filtered and used as elutriation water in the liquid cyclones. The scrubber ash slurry and glass plant reject water were kept separate from the water used in the Hydrasposal system and pumped to the wastewater treatment plant. The test was maintained until equilibrium conditions were achieved. (two weeks). The results of these closed loop tests are as follows; 1) the dissolved solids level reached equilibrium at 6 or 7 percent solids, 2) the solids content in the cone press process stream averaged 50 percent, 3) the total solids content in the whitewater system during this time was recuced somewhat by bacterial action. Apparently the whitewater system is aerobic and thus the aerobic bacteria help reduce the total solids content. The products of aerobic bacteria would be CO_2 and water, and thus, would help remove dissolved organic materials similar to what occurs in conventional activated sludge process. The water used during this closed loop period averaged 62 gallons per ton of refuse processed. The conclusions of these closed loop tests were that the solid waste plant could be operated on a closed loop basis without external connection to wastewater treatment plants. It should be noted that the Fiber Recovery System was not operated during this test because it produces an excess of water. However, it has been postulated that a similar closed loop operation could be utilized for the Fiber Recovery System. In this case internal treatment would be provided for solids and grease removal.

6.5 ENVIRONMENTAL IMPACT ON LAND

The original objective of the Franklin Solid Waste and Fiber Recovery Plant was to reduce the quantity of materials entering Franklin's landfill. The purpose of this was to extend the life of the existing landfill beyond the 3 or 4 years which was its expected remaining life. Without the Franklin Solid Waste Plant the landfill would be required to accept 175.6 tons per week. At 0.4 tons per cubic yard this would require 439 cubic yards of landfill volume per week. If it is assumed that all the unprocessable material, nonmagnetic junk, and cyclone rejects are landfilled, this would represent an average quantity of 35.8 tons per week. At an average density of 0.6 tons per cubic yard this would occupy 59.7 cubic yards per week. This represents an 86% savings in landfill volume.

The nature of the nonmagnetic materials as well as the cyclone rejects are such that higher compaction densities could be achieved with less effort. Land disposal of the cyclone rejects from the glass plant is done at a close proximity to the Franklin Solid Waste Plant. A pit is located just outside of the plant area which is used to landfill this material. By visual inspection the major portion of the material landfilled in this area is glass and small metallic pieces. The entire composition is similar to the cyclone rejects in appearance. Some fiber is present in this material.

Nuisance conditions as a result of landfilling this material are minimal. Some flies were present in the warmer weather and a slight unobjectionable odor is detectable. The material appears to be unsuitable for rodent burrowing. Land cover was not used and does not appear to be necessary. The nonprocessable junk and other nonmagnetic rejects from the pulping and separation subsystem are routinely deposited in a compactor and landfilled.

At certain times the magnetic rejects have been recycled to the head of the plant. These materials are then further reduced in size in the pulper, removed in the cyclone, and landfilled when the glass plant is not operated. Obviously the recycling of the magnetic materials to the head of the plant when the glass plant is not operating is a waste of effort.

6.6 NOISE POLLUTION

Systech performed a noise survey of the plant during normal operating conditions. This survey was conducted to determine if the area is in compliance with current Federal regulations.

The current regulations from the Occupational Safety and Health Act gives the following permissible noise level exposures. This standard defines the duration of exposure per day that an employee is permitted to the specified noise levels (dBA). The existing standard states that when a noise exposure is composed of two or more periods of noise exposure at different levels, then the maximum daily noise dose should not exceed unity when the noise dose is computed by the following equation:

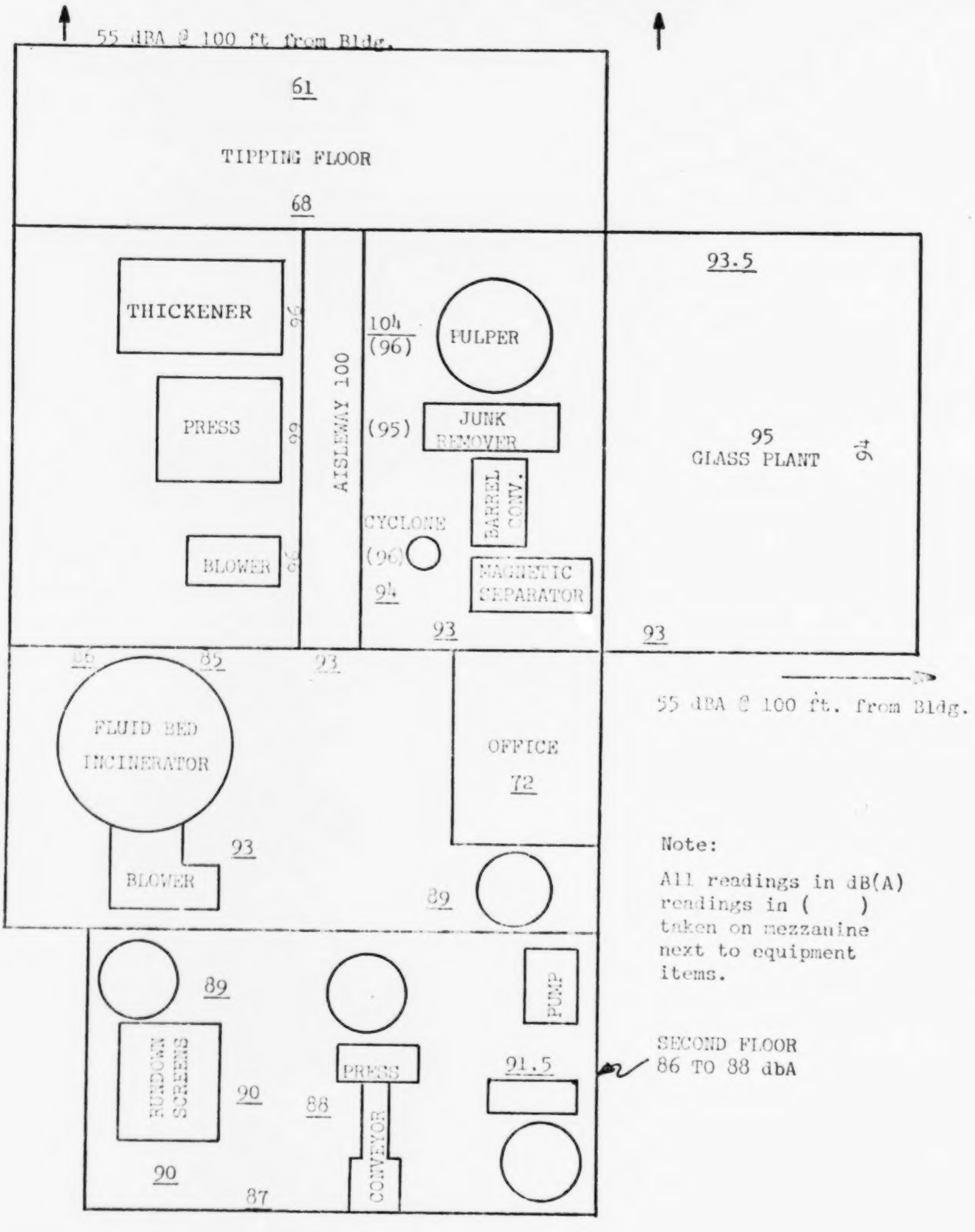
$$\text{NOISE DOSE} = \frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots \frac{C_n}{T_m}$$

C_n indicates total time of exposure at a specified noise level and T_n indicates total time of exposure permitted a that level.

Figure 34 illustrates the results of the noise survey at the Franklin Plant. As illustrated in this figure, the fiber recovery room is the only area where the noise level in the plant is less than 90 dBA (except for areas immediately adjacent to noise sources). Hence, personnel can work in the fiber recovery area full time and not be exposed to levels exceeding Federal Standards.

The reactor room, hydrapulper room and the glass plant, all have areas where the noise level exceeds 90 dBA. The hydrapulper generates noise levels up to 104 dBA (adjacent to the pulper). The blower in the reactor area causes the noise level in areas of this room to be greater than 90 dBA. The glass plant continously generates noise levels in the 93 to 95 dBA range.

Personnel involved in the operation of the reactor and hydrapulper are not required to be in the room during the operation of this equipment. Hence, these personnel are not exposed to noise levels exceeding OSHA standards. When personnel are working in these areas, they are normally performing a maintenance function and the equipment is not running.


55 dBA @ 100 ft from Bldg.
61
TIPPING FLOOR
68
THICKENER
96
PRESS
99
BLOWER
96
AISLEWAY 100
104
(96)
PULPER
(95)
JUNK REMOVER
BARREL CONV.
CYCLONE
(96)
MAGNETIC SEPARATOR
94
93
93.5
95
GLASS PLANT
94
93
55 dBA @ 100 ft. from Bldg.
86
85
93
FLUID BED INCINERATOR
BLOWER
93
OFFICE
72
89
89
RUNDOWN SCREENS
90
90
PRESS
88
CONVEYOR
87
PUMP
91.5
SECOND FLOOR
86 TO 88 dbA

Note:

All readings in dB(A)
readings in ( )
taken on mezzanine
next to equipment
items.

Figure 34 - NOISE LEVELS-FRANKLIN PLANT

A new plant of this type could easily make provisions for reducing the noise levels in the reactor room and the hydrapulper room. This can be accomplished by placing the hydrapulper and the reactor blower in separate rooms thus isolating them as noise sources.

It must be noted again that the project was conceived as a demonstration project and as such much has been learned about the operation and the changes that would need to be made in order to achieve noise compliance.

6.7 ODOR WITHIN AND OUTSIDE OF PLANT

During normal operation of the plant (and when the plant is not accepting sewage sludge for incineration), a slight garbage odor is detected outside, near the tipping floor, and within the plant. However, even adjacent to the tipping floor, the garbage odor problem is minimal. Outside the facility, 100 to 150 feet away, there is little or no detectable odor.

Within the plant during normal operation, there is of course a slight odor of raw garbage. To our personnel working at the plant, this odor was not considered to be a significant problem.

When the plant is accepting sludge from the Miami Conservancy District Waste Water TreatmentPlant, there is a significant sewage smell within the plant. This smell is given off at the injection nozzle at the screw conveyor, as well as from the cone press rejects. The water rejects from the press are highly contaminated (see Section 4) with sewage material. Also, the feed stock to the incinerator from the cone press gives off the sewage odor. This odor could be considered by many as very undesirable, but to personnel working in the wastewater treatment area, this odor is not a significant problem.

6.8 BACTERIOLOGICAL DATA

Samples were taken of the cyclone process stream, the whitewater system, the surge chest process stream, and recovered fiber. They were analyzed for bacterial contamination. The results are given in the following table:

STREAM	TOTAL COLIFORM CT	FECAL COLIFORM CT	TOTAL PLATE CT
Cyclone Process Stream	1.85×10^8/100ml	2.0×10^8/100ml	4.3×10^7/ml
Whitewater	2.0×10^8/100ml	1.3×10^7/100ml	2.8×10^7/ml
Surge Chest Process	1.65×10^8/100ml	1.0×10^7/100ml	1.0×10^8/ml
Recovered Fiber	---	1.35×10^6/100ml	4.27×10^{11}/100ml

It is evident from this table that all the process streams within the solid waste plant are highly contaminated and should be handled as such. Systech personnel working with this material use rubber gloves and are provided with a change of clothing. It is obvious (because of sprays and spillage) that air born bacteria are present. The sprays on the rundown screen in the Fiber Recovery System use the final effluent of the regional wastewater treatment plant. This effluent is chlorinated but airborn bacteria could be presentbecause of the sprays. Furthermore, because of poor drainage in the floor drains bacterial contamination is present. The possibility of airborn bacteria and respirable dust is evident because of leaks in the pneumatic conveying system (rotary value) and overhead conveyor in the dewatering and incineration subsystem. Additionally it should be noted that the recovered fiber is heavily contaminated and should be handled accordingly.

7.0 RESULTS OF ECONOMIC EVALUATION

7.1 INTRODUCTION

The Franklin Solid Waste and Fiber Recovery Plant is a special facility, designed to demonstrate the technique of wet processing for the disposal of solid waste as well as the recovery of some materials in the solid waste stream. It must be remembered that the plant was designed and constructed for demonstration purposes. As such, it enjoys many subsidies as well as extraordinary expenses whether they are evident, hidden, or implied. All of these factors skew the economic results actually being experienced.

The real objective of this phase of the effort was to develop a measure of the economics that would be experienced if any or all of the systems used at Franklin were incorporated in a solid waste facility that would be constructed and operated in competition with other disposal concepts. To accomplish this objective, it is necessary to know the costs associated with both the construction and the operation of the major systems and subsystems. It is not sufficient to evaluate the economics of the total concept as it now exists in Franklin. The reason for this is that other plants may not incorporate all three major systems used at Franklin. Indeed, because of the energy crisis, it is doubtful that a system identical to Franklin would ever again incorporate a reactor system that disposes of the residual solid waste and does not recover the heat generated in the process.

For these reasons, it was necessary to study the economics associated with each of the major systems. Four cost centers were used in this study. These are as follows:

(1) Weighing and Receiving;
(2) Pulping, Separation, Dewatering;
(3) Fluid Bed Reactor System; and
(4) Fiber Recovery System.

For clarity, the defined system includes the following unit operations:

(1) Weighing and Receiving - Includes operation of the scale, scale house, Bobcat, and other activities on the tipping floor.

(2) Pulping, Separation, Dewatering - Includes the operation of the feed conveyor to the pulper, junk remover, magnetic separator, cyclones, barrel thickener, cone press, and pneumatic feed to the reactor.

(3) Fluid Bed Reactor System - Includes the operation of the blower, reactor, scrubbing equipment, and other miscellaneous equipment required by the reactor.

(4) Fiber Recovery System - Includes the operation of the selectifier, cyclone, rundown screens, barrel thickener, cone press, and other miscellaneous equipment required in the fiber recovery system.

The data required to perform this economic evaluation was derived from information from various sources, i.e., EPA, Systech, A. M. Kinney, Black-Clawson, and the City of Franklin.

7.2 APPROACH TO DEVELOPING THE ECONOMIC DATA

The basis of the economic analysis stems from the actual operating experience being gained at Franklin. The approach used in developing the data incorporated the following steps:

(1) Collect data representative of the actual operating experience of Franklin and extend this data to reflect operating the plant at its design capacity (50 tons/day, 8 hour operation). The factors used to develop the Franklin operating experience include the following:

   (a) Revenues - metal and fiber sales, sludge disposal.

   (b) Operating Costs - operating labor, maintenance labor, operating supplies, building maintenance, maintenance materials, fuel costs, power consumption, material handling, land disposal, other expenses, and wastewater treatment.

   (c) Facility Expense - amortization and interest.

(2) Use this cost data to develop "non-dollar extensions of cost factors" for estimating costs for operating plants of 500 and 1,000 tons/day.

A cost factor was used to express expenses and revenues in scalable terms. Where possible, non-dollar related cost factors were used to reflect the absolute cost or revenues associated with an item. These factors were developed for expenses as well as revenues. These factors were then used to help study the economics for operating larger plants.

7.3 DEVELOPMENT OF NON-DOLLAR RELATED COST FACTORS FROM FRANKLIN EXPERIENCE

In order to have a complete understanding of all factors comprising the Income and Expense for the operation of the Franklin Plant and the projections to 500 and 1,000 tons/day, the following sections describes the income and expense categories used. The following data presents the cost factors for the Franklin Plant and projects these to the 500 and 1,000 tons/day Plants.

7.3.1 Income

Incomes realized for the operation of the Franklin plant are from three categories; metal sales, fiber sales, and sludge disposal. Monies received for the disposal of the solid waste will not be considered as income.

Metal is recovered from several locations within the plant. Large bulky recoverable metal is hand removed on the tipping floor and placed into a recovered bin. The largest metal fraction is recovered from the magnetic separator.

Fiber is recovered from the fiber recovery system of the plant. Revenues are received from the Logan Long Company, which uses this material in the manufacturing of roofing materials. Income from sludge disposal is received from the Miami Conservancy District, which operates the adjacent wastewater treatment plant. The derived income factors were developed based on an average percentage input of 9.8 and 40 for the magnetic metals and paper content respectively. The following table describes the steps used to develop the revenue factors.

Income Source	Percent of Material In Input Stream	Percent Recovered
Paper Fiber	40 percent	48%*
Magnetic Metals	9.8 percent	98%
Sludge	--	--

Income Source	Tons Material Recovered/ Ton Input	Assumed Market Val. $/T (Ave).	Income/ Ton Input
Paper Fiber	.192 T/T	$42.00/T	$8.06/T
Magnetic Metals	.096 T/T	$25.00/T	$2.40/T
Sludge	.07 T/T	$25.00/T	$1.75/%

*Actual operating experience showed this value to be much smaller. This was because of the large amount of time that fiber recovery was not operating. The revenue factors shown are for optimum operation of the Franklin Plant.

Although the system at Franklin is currently disposing of approximately 1 ton of sludge per day, it is capable of disposing of approximately 3.5 ton of sludge per day operating at 50 T/D.

The revenue factors derived can be used directly for any larger Franklin type system assuming that the characteristics of the input solid waste are approximately that as shown above.

7.3.2 Operating Expense Items

The following categories were developed and used for deriving the operating expenses of the Franklin Plant.

7.3.2.1 Operating Labor - This category defines the personnel involved in the operation of the Franklin Plant and also presents the projections for the operating labor force for the 500 and 1,000 T/D plants. The table on the following page presents this data.

The total manhours (MH) required by each of the facilities are:

Franklin 50 T/D - 32 MH
Franklin 500 T/D - 104 MH
Franklin 1,000 T/D - 152 MH

These manhours and appropriate rates can then be used to project operating labor costs for each size facility.

As illustrated in Table 12, the operating personnel being used for 35 T/D would also be able to operate the plant at 50 T/D.

7.3.2.2 Maintenance Labor - When the evaluation began, three personnel were involved with the maintenance activities at Franklin. Modifications and changes in operating schedules have effectively reduced this number to two personnel. Hence, the actual operating experience will reflect two maintenance personnel.

Scaling of the maintenance labor for the pulping and separation subsystem to larger facilities is not a linear relationship. This results from the fact that a larger hydrapulper is used and hence, the labor force required to maintain the pulper does not increase significantly, but the throughput of the pulper increases four (4) times. Thus, the maintenance labor cannot be scaled on a MH/T basis but should be scaled on a manhour/operating hour basis.

Since the Reactor System and the Fiber Recovery Systems for 500 and 1,000 T/D plants are basically duplicates of the Franklin facility and require only additional process lines, these systems can be scaled on a MH/T basis. The following Table presents the development of the cost factors to be used in projecting the costs for the three different sized systems. Furthermore, it is estimated that the maintenance manhours are distributed accordingly; 75 percent pulping and separation, 19 percent fiber recovery, and 6 percent reactor.

TABLE 12 - OPERATING LABOR

	Franklin 35-50 T/D				(3 shift total) 500 T/D				(3 shift total) 1000 T/D			
	W&R	P&S	Reactor	F.R.	W&R	P&S	Reactor	F.R.	W&R	P&S	Reactor	F.R.
Supervision						1				1		
Chief Operator		1				3				3		
Assistant Operator			1/4	3/4		1 3/4	1/4	1		3 1/2	1/2	2
Weighmaster	1				2				2			
General Labor		3/4		1/4		1 1/2		1/2		3		1
Office						2				3		

	35 T/D-50 T/D		Cost Factor	
	Manhours/D	Cost Factor	500 T/D	1,000 T/D*
Pulping & Separation	12	2.46 MH/HR	2.46	4.92
Reactor	1	.03 MH/T	.03	.03
Fiber Recovery	3	.085 MH/T	.085	.085

The P&S cost factor was derived from the following equation.

$$\frac{12 \text{ MH}}{35 \text{ T}} \times 7.2 \text{ T/D (Ave.)} = 2.46 \text{ MH/Operating Hr. of P\&S}$$

These cost factors were then used for projecting the costs for the larger sized facilities.

7.3.2.3 Operating Supplies - This category reflects all the costs for the operating supplies and includes all consummables required to operate the plant. This factor, by its nature cannot be non-dollar related. Franklin's operating experience shows this to be approximately $.30/ton input (based on 35 T/D average). Operating the facility at 50 T/D should not require more operating costs and hence, the operating cost per ton will be reduced. The table below presents the developed cost factors.

	35 T/D Operating Costs	Correction Factor to 50 T/D	50, 500, 1,000 T/D Operating Cost Factors
Weighing & Receiving	$.15/T	1	$.15
Pulping & Separation	$.15/T	35/50	$.11
Reactor	$.045/T	35/50	$.03
Fiber Recovery	$.045/T	35/50	$.03

These cost factors were then used for deriving the cost for the larger sized facilities.

7.3.2.4 Building Maintenance - As implied, this category reflects the costs for maintaining the building and premises in an operational manner.

Basically, the building area requirements for a Franklin system at 500 T/D would be approximately 1-1/2 times that at Franklin; and three times the area of Franklin for a 1,000 T/D facility. The building maintenance requirements were projected on a per ton basis. The following table presents the cost factors for the larger facilities, based on actual operating experience at Franklin.

---

* Equipment required is twice that for the 500 T/D Plant.

	35 T/D Operating Cost Factor	Correction Factor To 50 T/D	50,500,1,000 T/D Operating Cost Factor
Weighing & Receiving	$ .06/T	35/50	$ .042/T
P&S Dewatering	$ .02/T	35/50	$ .014/T
Reactor	$ .03/T	35/50	$ .022/T
Fiber Recovery	$ .03/T	35/50	$ .022/T

These cost factors were then used for estimating the cost for the larger sized facilities.

7.3.2.5 Maintenance Materials - This expense category reflects the costs for the purchase of the necessary replacement parts and equipment to keep the plant operational. It includes sub-contract work that may be required to maintain or replace a piece of equipment. It does not include the labor costs experienced by the operating staff, i.e., the labor cost for replacing a pump is reflected in the maintenance labor cost.

The maintenance replacement parts cost for the hydrapulper cannot be scaled linearly on a $/T basis for the larger facilities. The reason for this is that the wear factor for a larger hydrapulper is smaller than that of a smaller hydrapulper. Hence, replacement of worn parts would not be required as often. Therefore, for the purpose of projecting the maintenance material cost for the P & S subsystem of the plant, it was decided that the cost factor for this section should be represented by $/operating hour.

The manufacturer estimates that the larger hydrapulper lasts 1.6 times longer. In addition, in going from a smaller hydrapulper to a larger hydrapulper, the cost of replacement parts for similar items would increase by a factor of 2.25. Therefore, the resulting scale factor used to extrapolate the maintenance material expense from a 50 T/D system to a 500 T/D system is 2.25/1.6 or 1.4. In projecting costs from a 500 to 1,000 T/D facility, the cost factor for the P & S subsystem would be multiplied by two because the P & S section is duplicated (2 process lines).

Since all size plants have identical equipment for the Reactor System and the Fiber Recovery System, the material maintenance items can be scaled on a $/D basis.

Table 13 presents the development of the cost factors for the maintenance materials. The cost factors developed in this Table were then used for deriving the costs for the larger sized facilities.

7.3.2.6 Fuel Costs - This category reflects the costs for operating the front-end loader and for building heat. It does not reflect any fuel costs for the reactor because the bed temperature in the reactor is maintained so that it can burn the rejects without the addition of fuel. During the time of our study, the front-end loader consumed approximately 0.14 gallons/ton of gasoline and the fuel oil for building heat was consumed at a rate of .57 gallons/ton. Hence, correcting for the 50 T/D operation, the following lists the cost factors to be used for all three sized facilities.

	50, 500, 1,000 T/D
*Weighing and Receiving (Bobcat)	.14 gallons/ton
Pulping and Separation	.24 gallons/ton
Reactor	.07 gallons/ton
Fiber Recovery	.09 gallons/ton

*The Bobcat would require additional fuel for moving more tonnage and hence, the cost factor for a 35 T/D and 50 T/D operation would be the same.

7.3.2.7 Power Consumption - This expense category reflects the cost of power required to operate the equipment within the plant. During the study period, power consumption was measured for the Total Plant, Fiber Recovery System, Hydrapulper, and the Glass Plant. Since the Glass Plant data is not included in this report, the power consumed by the Glass Plant was subtracted from the total plant consumption. The hydrapulper and fiber recovery power consumption could be obtained directly. Thus, the power consumption of the P & S subsystem could be calculated. Using the installed horsepower for the reactor and the remaining equipment along with the data on their respective operating time, it was determined that the reactor consumed approximately 1/2 of the total power used in the P & S subsystem minus the Pulper. Hence, the following Table was derived for the power usage within the plant.

	35 T/D Cost Factor	50,500,1,000 T/D Cost Factor
Separation, Dewatering	56.4 KWH/T	56.4 KWH/T
Pulper	28.7 KWH/T	28.7 KWH/T
Reactor	56.4 KWH/T	56.4 KWH/T
Fiber Recovery	11.2 KWH/T	11.2 KWH/T

Power costs are based on two factors, energy and demand. Energy costs are computed using the total kilowatt-hours consumed. Demand costs are based on an average demand (kilowatts) measured at the facility by the power company.

TABLE 13 - MAINTENANCE MATERIAL COST FACTORS

	35 T/D Operating Costs Factor	Correction Factor to 50 T/D	Correction Factor 500 T/D	Correction Factor for 500 T/D	Correction Factor for 1000 T/D	Cost Factor for 1000 T/D
Weighing & Receiving	.57	1	.5	.385/T	.5	.192T
Pulping & Separation	25.70/HR	1	1.4	35.98/HR	2	71.97/HR
Reactor	.75/T	1	1	.75/T	1	.75/T
Fiber Recovery	.56/T	1	1	.56/T	1	.56/T

*3.57/T X 7.2

The demand load at the Franklin Plant is approximately 800 kilowatts. Because of the increase in the pulper size, in a 500 T/D plant the demand will be approximately 2,000 kilowatts. The demand for a 1,000 T/D plant will be the same as for 500 T/D because the equipment is the same size only the number of process lines change. Hence, the demand for a 500 T/D and 1,000 T/D plant will be approximately 2,000 kilowatts. The costs for energy and demand for this study were based on the rate schedule of the Cincinnati Gas and Electric Company.

7.3.2.8 Metal Handling - This category reflects the costs for removing the recovered metal from the operating area of the plant and preparing the material for shipping, etc. This cost factor was $.028/T and will be the same for all facilities.

7.3.2.9 Land Disposal - The disposal of the unprocessable material, the material issuing from the cyclone reject stream, and the non-magnetic stream sorted by the magnetic separator, requires land disposal. This material is generated according to the following factors, which will be used for projecting the land disposal costs for the larger facilities.

	Cost Factor
Weighing & Receiving	98.6 #/T
Pulping and Separation	281 #/T

7.3.2.10 Other Expenses - This expense category includes all other expenses that are included in operating the plant. They include insurance, plant security, taxes, etc. Operating experience at Franklin showed this to be $.71/T. The Table below shows an estimate of the breakout of this cost factor by cost center.

	35T/D-50T/D-500T/D-1,000T/D Operating Cost Factor
Weighing and Receiving	$ .10/T
Pulping, Separation, Dewatering	$ .30/T
Reactor	$ .20/T
Fiber Recovery	$ .11/T
	$ .71/T

7.3.2.11 Wastewater Treatment - Wastewater treatment services at Franklin are provided by Miami Conservancy District Wastewater Treatment Plant at a cost of .41¢/1,000 gallons sent to the plant. The facility provides for the treatment of water from the Hydrasposal system as well as from fiber recovery. It has been demonstrated (and discussed in an earlier section) that the Hydrasposal system can operate under a closed loop arrangement that essentially would require the treatment of little or no wastewater.

The Fiber Recovery liquid waste stream represents approximately 75% of the wastewater sent to the MCD Treatment Facility by the Solid Waste Plant. In a larger facility, this stream would probably be treated by using an on-site clarifier. The solids would be incinerated in the reactor, and some whitewater would be bled into the reactor to permit the addition of fresh water. This approach or a similar one would be used in a large plant because treatment costs at a wastewater treatment plant would be prohibitive. The following table presents the non-dollar related cost factors associated with the waste stream.

Franklin Operating Experience

Pulping, Separation, Dewatering	
BOD	39# BOD/T
SS	42# SS/T
Reactor (Ash H_2O)	
SS	12.8# SS/T
Fiber Recovery	
BOD	106# BOD/T
SS	181# SS/T

For the purpose of projecting the costs to 500 and 1,000 T/D, a rate of $0.25/T will be used. This cost factor approximation would assume a closed loop operation of the Hydrasposal system and the treatment of the Fiber Recovery Wastewater on site. Depending upon the approach used and the type of facility being designed (with or without a reactor) this cost could increase significantly. However, for projecting the estimated costs for the larger facilities, a rate of $0.25/T will be used.

7.3.3 Facility Expense

In order to develop a full economic evaluation, costs for each of the different sized facilities must be determined so that appropriate amortization and interest, depreciation or other related facility expenses can be derived. The following table presents the total sub-system costs for each of the three facilities.

	Franklin 50T/D-1969	500T/D-1974	1,000T/D-1974
Weighing & Receiving	$ 182,000	$ 1,103,000	$ 2,051,000
Pulp, Sep, Dewater	$ 626,000	$ 4,289,000	$ 7,987,000
Fluid Bed Incinerator	$ 670,000	$ 3,291,000	$ 6,133,000
Fiber Recovery	$ 509,000	$ 1,912,000	$ 3,551,000
TOTAL	$1,987,000	$10,595,000	$19,722,000

A table in Section 7.5.1 illustrates a comparison of equipment requirements for the 50, 500, and 1,000 T/D plant size.

7.3.3.1 Franklin Facility 35 Ton and 50 Ton/8-Hour Shift-150 Ton/21-Hour Shift - For the Franklin facility as it now exists, it would be unrealistic to assign a facility expense to its operation; because of its demonstration nature and because of the limited tonnage being received. The plant, as such, cannot enjoy any economy of scale and therefore, no facility charge will be considered in the analysis. Rather, the Franklin experience will be used to gather operational exepnse data. The capital investment for the facility is presented in the Tables for use by the reader is he so desires. If this cost is assigned to the operation of the plant, it should probably be prorated over the entire plant capacity, i.e., 150 T/D.

7.3.3.2 Franklin Type Facility - 500 and 1,000 T/D - There are many methods that can potentially be used to derive facility costs. Ownership of the facility is a major item of consideration. For purposes of developing facility costs for the larger facilities, it will be assumed that the facility will be owned by a municipality and that bonds (8 percent) will be issued to finance the facility. However, there are several factors that must be considered in deriving the facility expense cost. The total cost of the facility is not the amount of money that needs to be borrowed by the issuance of bonds to cover the facility costs. Factors such as finance charges, a debt service fund, and a debt reserve fund, (defined in the following table), cause the total bond issue to be approximately 30 percent higher than the actual cost of the facility. Hence, a facility expense to cover the Amortization and Interest (A & I) rate would then have to be based on the value of the total bond issue. For the purposes of this analysis (projecting operating costs for the 500 and 1,000 T/D facility) an annual A & I rate of 10 percent will be used (based on 20 year life of major equipment and facility). For the 500 and 1,000 T/D facilities, the following Table will present these costs.

	500 T/D		1,000 T/D	
Project Cost	10,595,000		19,722,000	
*Total Bond Issue	13,508,000		25,145,000	
Annual A & I	1,350,000	($10.45/T)	2,514,000	($9.73/T)

* Debt Service Fund - the amount of money that has to borrowed to make payments on the bond issue during the construction period (2 years).

- Debt Revenue Fund - money that is withheld and invested (8 percent) to make sure one payment on the bond issue can be made. This reserve is held throughout the bond payment period to insure that the payments can be made on time.

- Finance Charge - the amount of money charged by the agency preparing and issuing the bonds.

These three categories cause the total bond issue to be approximately 30 percent higher than the actual facility cost.

7.4 FRANKLIN OPERATING EXPERIENCE - ACTUAL 35 T/D, PROJECTED 50 T/D AND PROJECTED 150 T/D

Table 14 presents a summary of the actual income and expense for the Franklin plant operating at an average throughput of 35 T/D. This table illustrates these costs as a function of four (4) cost centers (Weighing and Receiving, Incinerator and Fiber Recovery). As illustrated, this facility is showing an operating loss of approximately $4,40/ton, excluding a facility expense cost. Some interesting observations can be drawn from the following table.

	% of Total Operating Costs	% of Total Revenue
Weighing & Receiving	10.6%	-
Pulping, Separation, & Dewatering	54%	31%
Fluid Bed Reactor	18.5%	11%
Fiber Recovery	16.9%	57.5%

The major point to be made is that Fiber Recovery provides 57.5 percent of the total revenue while only accounting for 16.9 percent of the total operating cost. This most certainly justifies a fiber recovery system if there is a suitable customer and the market conditions are favorable.

Projecting these costs to 50 T/D (Table 15) shows that the plant without a facility expense charge, can operate at approximately a $0.26/T profit. This figure was derived considering optimum operation of the plant. The large difference between the two (35 and 50 T/D) is that income shows a value of 9.08/T for the 50 T/D, an increase of 2.48/T based on actual operation. This increase is based on Fiber Recovery operating full time.

TABLE 14 MONTHLY FRANKLIN ACTUAL OPERATING EXPERIENCE 35T/D x 750T/M

	Total Plant		Weighing & Receiving		Pulping, Separation and Dewatering		Reactor		Filer Recovery	
	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton
INCOME										
Metal Sales	$1,564	$2.08/T			$1,564					
Fiber Sales	2,865	3.81/T							$2,865	
Sludge Disposal	537	.71/T					537			
	$4,966	$6.60/T			$1,564	$2.07/T	$537	$.71/T	$2,865	$3.80/T
EXPENSES										
1. Operating Labor										
Chief Operator	$ 860	$1.14/T			$860					
All Others	2,580	3.43/T	$860		645		$215		$860	
2. Maintenance Labor	1,702	2.26/T			1,269		113		320	
3. Operating Supplies	292	.39/T	112		112		34		34	
4. Building Maintenance	75	.10/T	32		11		16		16	
5. Maintenance Materials	4,175	5.55/T	428		2,762		564		421	
6. Fuel - Gasoline	53	.07/T	53							
Fuel Oil (Heat)	117	.15/T			72		21		24	
7. Power - Energy	1,799	2.39/T			1,003		664		132	
Demand - 800 KW	1,500	1.99/T			563		937			
8. Metal Handling	211	.28/T			211					
9. Land Disposal										
10. Other Expenses	533	.71/T	75		225		150		83	
11. Wastewater Treatment	770	1.02/T			193				577	
	$14,667	$19.50/T	$1,560	$2.07/T	$7,926	$10.53/T	$2,714	$3.61/T	$2,467	$3.28/T

INCOME & EXPENSE SUMMARY*

Income	$ 6.60/T
Expenses	19.50/T
NET COST	(12.90/T)
Average Dump Fees	8.50/T
Operating Loss	(4.40/T)

*Does not include a Facility Expense Charge

TABLE 15 MONTHLY FRANKLIN PROJECTED OPERATING EXPERIENCE - 50T/D x 1075T/M

	Total Plant		Weighing & Receiving		Pulping, Separation and Dewatering		Reactor		Fiber Recovery	
	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton
INCOME										
Metal Sales	$2,236	$2.08/T			$2,236					
Fiber Sales	6,761	6.29/T							$6,761	
Sludge Disposal	537	.71/T					$ 537			
	$9,534	$9.08/T			$2,236	$2.08/T	$ 537	$.71/T	$6,761	$6.29/T
EXPENSES										
1. Operating Labor										
Chief Operator	$ 860	$ .80/T			$ 860					
All Others	2,580	2.40/T	$ 860		645		$ 215		$ 860	
2. Maintenance Labor	2,441	2.27/T			1,824		161		456	
3. Operating Supplies	343	.32/T	161		118		32		32	
4. Building Maintenance	108	.10/T	45		15		24		24	
5. Maintenance Materials	5,832	5.42/T	612		3,812		806		602	
6. Fuel - Gasoline	75	.07/T	75							
Fuel Oil (Heat)	167	.15/T			103		30		34	
7. Power - Energy	2,570	2.39/T			1,433		949		188	
Demand - 800 KW	1,500	1.39/T			563		937			
8. Metal Handling	301	.28/T			301					
9. Land Disposal										
10. Other Expenses	762	.71/T	107		322		215		118	
11. Wastewater Treatment	1,101	1.02/T			276				825	
	$18,640	$17.32/T	$1,860	$1.73/T	$10,272	$9.55/T	$3,369	$3.13/T	$3,139	$2.92/T

INCOME & EXPENSE SUMMARY*

Income	$ 9.08/T
Expense	17.32/T
NET COST	(8.24/T)
Average Dump Fees	8.50/T
Operating Profit	$ .26/T

*Does not include a Facility Expense Charge

Table 16 presents the projected operating costs to 150 T/D (the plants design capacity). Without a facility expense charge, Table 16 shows that the plant can operate at a $2.36/T profit. Again, this figure was derived considering optimum operation of the plant.

7.5 PROJECTION TO 500 and 1,000 T/D SIZE PLANT

7.5.1 Introduction

Before presenting the estimated operating costs for a 500 and 1,000 T/D facility, some discussion about the facilities is necessary.

Each of the two facilities will be three (3) shift operations, with a 20 hour process time for the maximum capacity. The 500 T/D facility would require approximately 1-1/2 times the building floor area that is currently used by the Franklin Plant. The table below illustrates the equipment requirements for the larger facilities.

EQUIPMENT REQUIREMENTS

50 T/D Franklin - 7 Hr

1 Hydrapulper
1 Reactor
1 Dewatering Equipment
1 Fiber Recovery System

500 T/D - 20 HR

1 Hydrapulper (larger)
1 Reactor (larger)
4 Dewatering Equipment
3 Fiber Recovery Systems

1,000 T/D - 20 HR

2 Hydrapulpers
2 Reactors
8 Dewatering Equipment
6 Fiber Recovery Systems

The non-dollar related cost factors for projected facility cost were presented in Sections 7.2 and 7.3. These factors are again identified on the operating cost tables presented in this section.

TABLE 16 MONTHLY FRANKLIN PROJECTED OPERATING COST - 150T/D (OPTIMUM)-3225T/M.

	Total Plant		Weighing & Receiving		Pulping, Separation and Dewatering		Reactor		Fiber Recovery	
	Dollars	$Per Ton	Dollars	$Per Ton	Dollars	$Per Ton	Dollars	$Per Ton	Dollars	$Per Ton
INCOME										
Metal Sales	$ 6,708 -	$2.08/T			$6,708					
Fiber Sales	20,285 -	6.29/T							$20,285	
Sludge Disposal	2,289 -	.71/T					$2,289			
	$29,282 -	$9.08/T			$6,708	$2.08/T	$2,289.	$.71/T	$20,285	$6.29/T
EXPENSES										
1. Operating Labor										
Chief Operator	$ 860	$ .27/T			$860					
All Others	6,020	1.86/T	$860		1,935		$645		$2,580	
2. Maintenance Labor	7,406	2.27/T			5,535		488		1,383	
3. Operating Supplies	1,032	.32/T	485		355		96		96	
4. Building Maintenance	322	.10/T	134		44		72		72	
5. Maintenance Materials	17,492	5.42/T	1,834		11,429		2,415		1,804	
6. Fuel - Gasoline	225	.07/T	225							
Fuel Oil (Heat)	167	.05/T			103		30		34	
7. Power - Energy	7,710	2.39/T			4,299		2,847		564	
- Demand	1,500	.46/T			563		937			
8. Metal Handling	903	.28/T			903					
9. Land Disposal										
10. Other Expenses	2,289	.71/T	321		969		645		354	
11. Wastewater Treatment	3,289	1.02/T			824				2,465	
	$49,205	$15.22/T	$3,859	$1.18/T	$27,819	$8.61/T	$8,175	$2.53/T	$9,352	$2.90/T
INCOME & EXPENSE SUMMARY*										
Income	$29,282	$9.08/T								
Expenses	49,205	15.22/T								
NET COST	($19,923)	(6.14/T)								
Average Dump Fees	27,412	8.50/T								
Operating Profit	$ 7,489	$2.36/T								

Notes for Tables 14, 15, and 16

Income Notes:

1. Fiber dollars based on 30% input in solid waste
2. Sludge disposal is provided at 1 T/D for $25./T

Expense Notes:

1. Chief operator labor rate is $7./hr including fringes
2. All other operators labor rate is $5./hr including fringes.
3. Gasoline is purchased at $ .50/gallon
4. Fuel oil is purchased at $ .40/gallon
5. Power costs are computed using Cincinnati Gas and Electric scale.
6. No cost for land disposal are being incurred at Franklin (disposal is on-site)
7. Wastewater Treatment is provided at a rate of .41¢/1000 gallon ≈ 2500 gal/T being treated.

Average Dump Fee

Includes Revenue from Private and Individual Haulers.

The cost estimates do not reflect the cost of land. This value varies considerably (depending upon where the facility is constructed) and hence, will not be considered in this analysis.

All labor rates and other schedules for determining the total category costs are presented in the notes for each projected facility cost.

7.5.2 Estimated Cost for 500 T/D Franklin Type Facility

Table 17 presents an estimated cost summary for the operation of a 500 T/D Franklin type facility. The data presented is for optimum operating condition. The rates used for labor and other non-dollar related cost factors used in the development of this data have been presented in Sections 7.3. Additional notes are presented on the page following the table.

As illustrated in this table, income from recovered material amount to $12.21/T. Operating expenses are 9.96/T and the facility expense is 10.46/T. Hence, the net cost of the operation is 8.21/T.

As indicated previously in this section, the possibility of ever building another facility like this is very remote. Hence, let us look at the possibility of selling the rejects being consumed in the reactor as a fuel (material is removed from premises by buyer of fuel). A current value for this material would be approximately $1.25 million BTU. Assuming an average BTU content of 7,200 BTU/# of the rejects as they go to the reactor (on a dry basis) and a .21 T/T input factor for the amount of potential fuel generated, the following table can be developed.

Ton/Month	10,750 T
Tons of Rejects	2,257 T
#'s to Reactor	4,515,000 lbs.
Total BTU's	$4.515 \times 10^6 \times 7{,}200 = 3.25 \times 10^{10}$
Value of Fuel	$40,600.00/month or $3.78/T

Hence, the following summary can be derived for the operating costs of a 500 T/D facility with fuel recovery.

Income	$12.21/T*
Operating Expense	$ 7.75/T
Facility Expense	$ 7.21/T
Income on Fuel	$ 3.78/T
Net Savings	$ 1.03/T

---

*Sludge can still be processed and disposed of in this system.

TABLE 17 MONTHLY FRANKLIN FACILITY COSTS PROJECTED TO 500T/D - 10750T/M

	Total Plant		Weighing & Receiving		Pulping, Separation and Dewatering		Reactor		Fiber Recovery	
	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton
INCOME										
Metal Sales	$25,800	$2.40/T			$25,800					
Fiber Sales	86,645	8.06/T							$86,645	
Sludge Disposal	18,812	1.75/T					$18,812			
	$131,257	$12.21/T			$25,800	$2.40/T	$18,812	$1.75/T	$86,645	$8.06/T
EXPENSES										
1. Operating Labor										
Supervision	$ 1,290	$ .12/T			$ 1,290					
Chief Operator	3,096	.29/T			3,096					
Office	1,376	.13/T			1,376					
All Others	6,020	.56/T	$ 1,720		2,795		$ 215		$ 1,290	
2. Maintenance Labor	11,469	1.07/T			5,289		1,612		4,568	
3. Operating Supplies	3,438	.32/T	1,612		1,182		322		322	
4. Building Maintenance	1,023	.10/T	401		150		236		236	
5. Maintenance Materials	33,691	3.13/T	4,138		15,471		8,062		6,020	
6. Fuel- Gasoline	762	.07/T	762							
Fuel Oil (Heat)	1,677	.16/T			1,032		301		344	
7. Power - Energy	23,931	2.23/T			13,337		8,839		1,755	
Demand	3,338	.31/T			1,252		2,086			
8. Metal Handling	3,010	.28/T			3,010					
9. Land Disposal	3,059	.28/T	794		2,265					
10. Other Expenses	7,632	.71/T	1,075		3,225		2,150		1,182	
11. Wastewater Treatment	2,687	.25/T							2,687	
	$107,239	$ 9.96/T	$ 10,542	$ .98/T	$54,470	$5.06/T	$23,823	$2.21/T	$18,404	$1.71/T
FACILITY EXPENSE										
Project Cost	$10,595,000		$1,103,000		$4,289,000		$3,291,000		$1,912,000	
Total Bond Issue	13,508,000									
Monthly A&I (10%)	112,500	$10.46/T	$11,610	$1.09/T	$45,150	$4.24/T	$34,615	$3.24/T	$20,102	$1.88/T

COST SUMMARY

Income	$12.21/T
Expense	(9.96/T)
Facility Expense	(10.46/T)
NET COST	($ 8.21/T)

As can be seen from this illustration, when the rejects stream is sold as a fuel, the plant operates at a net savings of $1.03/T as compared to a net cost of $8.21/T when operating with the reactor. It should be remembered that there has been no charge for the disposal of refuse assigned to these examples.

With the information presented in Table 17, the costs associated with any one of the systems can be derived. As illustrated, the system becomes very economically attractive when the rejects stream can be sold as a fuel.

7.5.3 Estimated Cost for 1,000 T/D Franklin Type Facility

Table 18 presents an estimated cost summary for the operation of a 1,000 T/D Franklin type facility. The data presented is for optimum operating conditions. Again, the application rates for labor and other non-dollar related cost factors used in the development of this data have been presented in Section 7.3. Additional Notes are presented on the page following the table. As illustrated in Table 18, income from recovered materials and sludge disposal amount to $12.21/T. Operating expenses are 9.32/T and the facility expense is $9.73/T. Hence, the net cost of operation is $6.84/T.

Assuming the sale of the reject stream as a fuel, and the removal of the reactor from the system, the net cost of the operation is as follows:

Income	$12.21/T	(Includes Sludge Disposal)
Operating Expense	-7.21/T	
Facility Expense	-6.70/T	
Income on Fuel	3.78/T	
Net Savings	$ 2.08/T	

Again, the use of the feed material to the reactor as a supplemental fuel based on $1.25/1,000,000 BTU (7,200 BTU/# ave.), and income of $2.08/T can be derived. As illustrated in Table 18, the cost of the reactor system is approximately 1/2 of the total facility cost. Hence, the main reason for the net income of $2.08/T is because of the high cost of the reactor system.

7.5.4 Cost Summary

As illustrated in Table 14, the Franklin Solid Waste and Fiber Recovery Plant, as it currently operates (average 35 T/D), has an operating loss of $4.40/T. This cost figure does not include an expense for the facility but does include a dump fee of $8.50/ton.

TABLE 18 MONTHLY FRANKLIN FACILITY COSTS PROJECTED TO 1000T/D - 21500T/M

	Total Plant		Weighing & Receiving		Pulping, Separation and Dewatering		Reactor		Fiber Recovery	
	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton	Dollars	$ Per Ton
INCOME										
Metal Sales	$ 51,600	$2.40/T			$51,600					
Fiber Sales	173,290	8.06/T							$173,290	
Sludge Disposal	37,625	1.75/T					$37,625			
	$262,515	$12.21/T			$51,600	$2.40/T	$37,625		$173,290	$8.06/T
EXPENSES										
1. Operating Labor										
Supervision-7.50/hr	$1,290	$ .06/T			$ 1,290					
Chief Operator-6.00/hr	3,096	.14/T			3,096					
Office-4.00/hr	2,064	.10/T			2,064					
All Others-5.00/hr	10,320	.48/T	$ 1,720		5,590		$ 430		$ 2,580	
2. Maintenance Labor 5.00/hr	22,940	1.06/T			10,578		3,225		9,137	
3. Operating Supplies	6,880	.32/T	3,225		2,365		645		645	
4. Building Maintenance	2,150	.10/T	903		301		473		473	
5. Maintenance Materials	63,240	2.94/T	4,128		30,947		16,125		12,040	
6. Fuel- Gasoline	1,505	.07/T	1,505							
Fuel Oil (Heat)	3,354	.15/T			2,064		602		688	
7. Power - Energy	47,601	2.21/T			26,528		17,582		3,491	
Demand	3,318	.15/T			1,232		2,086			
8. Metal handling	6,020	.28/T			6,020					
9. Land Disposal	6,120	.28/T	1,589		4,531					
10. Other Expenses	15,265	.71/T	2,150		6,450		4,300		2,365	
11. Waste Water Treatment	5,375	.25/T							5,375	
	$200,558	$ 9.32/T	$ 15,220	$ .71	$103,076	$4.79/T	$45,468	$2.11/T	$ 36,794	$1.71/T
FACILITY EXPENSE										
Project Costs	$19,722,000		$2,051,000		$7,987,000		$6,133,000		$3,551,000	
Total Bond Issue	$25,145,000									
Monthly A&I (10%)	$ 209,200	$ 9.73/T	$21,715	$1.01/T	$84,710	$3.94/T	$65,145	$3.03/T	$37,625	$1.75/T

COST SUMMARY

Income	$12.21/T
Expense	(9.32/T)
Facility Expense	(9.73/T)
NET COST	$(6.84/T)

Notes for Tables 17 and 18

Income:

1. Metal sales are based on 9.8% input and selling at $25./T
2. Fiber Sales are based on 40% input and selling at $42./T
3. Sludge is disposed of at a rate of .07 T/T input at $25./T

Expenses:

1. Operating Labor

   Supervision labor rate - 7.50/hr including fringes

   Chief Operator - 6.00/hr " "

   Office - 4.00/hr " "

   All Others - 5.00/hr " "
2. Maintenance labor rate - 5.00/hr " "
3. Gasoline costs computed at $ .50/gallon
4. Fuel oil costs computed at $ .40/gallon
5. Power costs were derived from Cincinnati Gas and Electric Power scale
6. Sanitary landfill costs were computed at $1.50/T

Table 19 presents an economic summary of a Franklin type plant projected to 150, 500, and 1,000 T/D. As illustrated, the net operating costs are $12.35 per ton for the 150 ton per day facility; $8.21 per ton for the 500 ton per day; and $6.84 per ton for the 1,000 ton per day plant. These numbers compare quite favorably with typical solid waste disposal costs, such as those for incineration or landfill. Incineration costs range from $10.00 to $15.00 per ton and landfilling costs typically range from $3.00 to $10.00 per ton. The most significant effect can be seen to be the important decrease in operating expense per ton in the scaling up from 150 to 500 tons per day.

In contrast to Franklin type plant, Table 20 presents an economic summary of a wet processing plant without fiber recovery, but with the organic rejects sold as a fuel product. Projected to 150, 500, and 1,000 tons per day the addition of fuel recovery results in a net cost of 21¢ per ton at the 150 ton per day level, a net savings of $3.39 per ton at the 500 ton level, and a net savings of $4.13 per ton at the 1,000 ton per day level. One important difference between these two types of plants is the $10.71 per input ton for fuel as opposed to an $8.06 per input ton for recovered paper fiber. Most important, however, is the large decrease in the facility expense charge resulting from the reduction in capital costs when the fiber recovery equipment is removed from the total plant capital costs. In the data presented in Table 19 and 20, no tipping fee is included in the analysis, hence the net operating costs can be compared directly to existing disposal costs with the following exception. It should be noted that for all these examples no charge is made for the land on which the facility is to be established. Individual communities may readily approximate the cost of land locally and add the appropriately amortized capital cost of the land to the facility expense charge to obtain a specific projection for their community.

TABLE 19 - Economic Summary of Projected Franklin Type Facility

FACILITY COSTS	Franklin Projected To 150 T/D	Franklin Projected To 500 T/D	Franklin Projected To 1000 T/D
Income*			
Paper Fiber	$8.06/T	$8.06/T	$8.06/T
Magnetic Metals	$2.40/T	$2.40/T	$2.40/T
Sludge Disposal	$1.75/T	$1.75/T	$1.75/T
	$12.21/T	$12.21/T	$12.21/T
Operating Expenses	$15.22/T	$9.96/T	$9.32/T
Facility Expense** (20 yr. depr.)	$9.34/T	$10.46/T	$9.73/T
NET COST	$12.35/T	$8.21/T	$6.84/T

---

*Based on Following Revenue Factors
Magnetic Metals - 9.8% Input - Selling at $25.00/T
Fiber - 40% Input - Selling at $42.00/T
Sewage Sludge - Disposed of at a rate of .07T/T Input - $25.00/T

**Based on Following Facility Costs Projected to 1974 Prices

	150T/D	500T/D	1000T/D
Weighing & Receiving	$254,800	1,103,000	$2,051,000
Pulping, Separation, and Dewatering	876,400	4,289,000	7,987,000
Fluid Bed Reactor	938,000	3,291,000	6,133,000
Fiber Recovery	712,600	1,912,000	3,551,000
TOTAL PLANT COST	$2,781,800	$10,595,000	$19,722,000

TABLE 20 - Economic Summary of Projected Franklin Plan with No Fiber Recovery and Using Rejects as a Fuel.

FACILITY COSTS	Franklin Projected To 150 T/D	Franklin Projected To 500 T/D	Franklin Projected To 1,000 T/D
Income*			
Magnetic Metals	$ 2.40/T	$ 2.40/T	$ 2.40/T
Sludge Disposal	$ 1.75/T	$ 1.75/T	$ 1.75/T
Fuel	$10.71/T	$10.71/T	$10.71/T
	$14.86/T	$14.86/T	$14.86/T
Operating Expenses	$11.28/T	$ 6.04/T	$ 5.50/T
Facility Expense** (20 Year Depr.)	$ 3.79/T	$ 5.43/T	$ 5.05/T
NET SAVINGS	($ 0.21/T)	$ 3.39/T	$ 4.13/T

---

*Based on Following Revenue Factors
Magnetic Metals - 9.8% Input - Selling at $25.00/T
Sludge Disposal - Disposed of at a rate of .07T/T Input - $25/T
Fuel - $1.25/1,000,000 BTU

**Based on following facility costs projected to 1974 prices.

	150 T/D	500 T/D	1,000 T/D
Weighing & Receiving	$ 254,800	$1,103,000	$2,051,000
Pulping, Separation and Dewatering	$ 876,400	$4,289,000	$7,987,000
TOTAL PLANT COST	$1,131,200	$5,392,000	$10,038,000

LIST OF APPENDICES

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APPENDIX A

EQUIPMENT DESCRIPTIONS

1. CONVEYOR

LOCATION: Conveyor pit in tipping floor area.

MANUFACTURER: Webster Manufacturing Company

DESCRIPTION: The conveyor consists of bins 60 inches wide, 3/8 inch thick, and 4 inches high on the sides. An angular steel pusher bar is placed at every fourth bin to prevent slippage of the solid refuse.

CAPACITY: Seven (7) tons per hour; plus a 25% surge.

FUNCTION: Moves processable refuse to the Hydrapulper.

2. HYDRAPULPER

LOCATION: Hydrasposal "A" Subsystem

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: The hydrapulper is 12 ft. in diameter with a base-mounted rotor driven by a 300 h.p. motor. A side-mounted junk remover removes metal, tin cans, and other non-friable materials from the hydrapulper. Recycled water is mixed with the incoming refuse, and by the cutting action of the high speed rotor all pulpable materials are macerated into a liquid slurry.

CAPACITY: Design capacity is six (6) tons per hour of incoming refuse. The actual operating capacity is seven (7) to eight (8) tons per hour.

FUNCTION: Accomplishes size reduction of the incoming solid waste and production of liquid slurry.

3. DUMP PUMP

LOCATION: Base of Hydrapulper

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: A Black-Clawson 5-inch BM, 500 gpm at 60 feet tdh.

DRIVE: 30 h.p./1200 rpm motor

FUNCTION: Pumps the liquid slurry to the liquid cyclone.

4. JUNK REMOVER

LOCATION: Side of hydrapulper

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: Chain-operated buckets which capture large, non-friable materials.

DRIVE: 5 h.p./1800 rpm motor; conveyor speed of 40 fpm.

CAPACITY: 3000 pounds/hour; 60 cubic feet/hour

FUNCTION: Removes non-friables from the hydrapulper and conveys them to the junk washer.

5. JUNK WASHER

LOCATION: Next to hydrapulper unit

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: Rotating, continuous-type Ransohoff scrap washer.

DRIVE: 1/2 h.p. with sycrogear; barrel speed 5 rpm.

CAPACITY: 3000 pounds/hour; 60 cubic feet/hour

FUNCTION: Originally designed with water sprays for washing slurry from the removed materials. Currently provides conveying action to magnetic sorter transport.

6. MAGNETIC SEPARATOR

LOCATION: Hydrasposal "A" Subsystem: near junk washer output

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: The transport conveyor bringing materials from the junk washer passes the materials under the magnetic separator. The transport conveyor is a 24-inch wide rubber-belted conveyor with cross flights on approximately 24-inch centers. The belt turns at 200 fpm and is powered by a 3/4 h.p. motor. The separator is electromagnetic with a 300 fpm face conveyor, rubber-belted, with aluminum cross-flights and is powered by a two (2) h.p. motor.

FUNCTION: Separation of magnetic and non-magnetic material is accomplished by means of the electromagnetic conveyor located just above the transport conveyor. Magnetic materials are picked up by the separator and dumped into a 60-inch deep, drop-bottom hopper while the non-magnetics fall from the end of the transport conveyor into a second hopper.

7. LIQUID CYCLONE

LOCATION: Hydrasposal "A" Subsystem - next to junk washer

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: A self-contained, ceramic-lined cyclone with automatically controlled (timed) dump valves.

CAPACITY: 100 gpm with a pressure drop of 20 psi

FUNCTION: Removal of dense, coarse grit from the hydrapulper process stream.

8. SELECTIFIER DILUTION TANK

LOCATION: Fiber Recovery System

DESCRIPTION: 3/8 inch thick steel sides x 1/4 inch thick steel bottom. Tank diameter is 10 feet; tank height is 7 feet.

FUNCTION: Receives input from the liquid cyclone process stream and dilution input from the whitewater system. Provides for the dilution of the liquid cyclone process stream prior to entering the selectifier.

9. SELECTIFIER

LOCATION: Fiber Recovery System

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: 0.062-inch diameter pressure screen, with a ten (10) h.p./1800 rpm motor drive.

CAPACITY: 900 gpm with 0.6 percent input slurry.

FUNCTION: The input slurry is received from the selectifier dilution tank. The more coarse materials (greater than 0.062 inches in diameter) are screened out. These reject materials are directed to the rejects tank while the selectifier process stream is directed to the cleaners supply tank.

10. CLEANERS SUPPLY TANK

LOCATION: Fiber Recovery System

DESCRIPTION: 3/8 inch steel sides x 1/4 inch steel base. Tank dimensions are eight (8) feet wide x ten (10) feet high.

11. CENTRIFUGAL CLEANERS

LOCATION: Fiber Recovery System

MANUFACTURER: Bauer Brothers - 16 units, #606-110P

DESCRIPTION: Bank of 16 units; presently 5 are connected in parallel operation to optimize removal efficiencies.

CAPACITY: 1700 gpm

FUNCTION: Receives input from the Cleaner Supply Tank. Acts to separate the small, dense particles of grit and glass from the process streams. The output of the cleaners enters the rundown screen units. The reject stream enters the reject tank.

12. RUNDOWN SCREENS

LOCATION: Fiber Recovery System

MANUFACTURER: Bauer Brothers - 48" width

DESCRIPTION: .020 inch slotted screens of non-clogging design, with addition of spay headers to aid in fiber separation and prevent screen blockage.

CAPACITY: 1500 gpm input flow

FUNCTION: Receives input from Centrifugal Cleaners Process Stream. Provides for recovery of fiber in stream and removal of fines. Material less than .020 inches in diameter passes through screens and enters whitewater system. Recovered fiber falls off end of screen into stock sump, to barrel thickener in Fiber Recovery System.

13. BARREL THICKENER - FIBER RECOVERY

LOCATION: Fiber Recovery System

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: 2 barrels with 9-inch screws for dewatering

CAPACITY: Input flow 175 gpm

FUNCTION: Receives input from stock sump of rundown screens. Dewaters the fibrous slurry to approximately 12 percent solids and discharges to the Rietz Cone Press. The rejects enter the Whitewater system. .

14. RIETZ CONE PRESS

LOCATION: Fiber Recovery System

MANUFACTURER: Rietz Manufacturing Company - "V" press Model RVP - 36

DESCRIPTION: Press wheel diameter is three feet, driven by one (1) 20-h.p. and two (2) 5-h.p. motor.

CAPACITY: 42 pounds of (oven-dry) solids per minute

FUNCTION: Receives input from the barrel thickener and further dewaters this material to approximately 40 percent solids.

15. FIBER DILUTION TANK

LOCATION: Fiber Recovery System (outdoor)

DESCRIPTION: Square steel outdoor tank next to Fiber Recovery System.

FUNCTION: Receives dewatered fiber from cone press and with appropriate pumps provides for re-dilution with non-dewatered fibers from stock sump. The re-diluted fiber stock is then pumped via pipeline to the Logan Long Company.

16. REJECTS TANK

LOCATION: Fiber Recovery System (inside)

DESCRIPTION: 3/8" steel sidewalls and 1/4" steel bottom. Five (5) feet in diameter and Seven (7) feet high.

FUNCTION: Receives the reject streams from various units in the Fiber Recovery System. The output is pumped to the surge chest for ultimate incineration.

17. SURGE CHEST

LOCATION: Hydrasposal "B" Subsystem (large outdoor tank)

DESCRIPTION: 60,000 gallon capacity, outdoor tank constructed of A 36 steel plats, commercial quality HRS. Field-welded, sandblasted and epoxy-painted.

FUNCTION: Receives Slurry from the liquid cyclone and rejects from the Fiber Recovery System prior to entering the Hydrasposal "B" Subsystem.

18. BARREL THICKENER - HYDRASPOSAL "B"

LOCATION: Hydrasposal "B" Subsystem

MANUFACTURER: Black-Clawson Corporation

DESCRIPTION: Three barrels with three (3) 16 inch, inclined, diminishing pitch screws driven by individual 15-h.p. motors.

CAPACITY: 350 gpm

FUNCTION: Receives input from surge chest and dewaters the slurry approximately 10 percent solids prior to entering the cone press.

19. RIETZ CONE PRESS - HYDRASPOSAL "B"

LOCATION: Hydrasposal "B" Subsystem

MANUFACTURER: Rietz Manufacturing Company - "V" press Model RVP 60.

DESCRIPTION: Press wheel diameter is 5 feet; driven by one (1) 50-h.p. and two (2) 10-h.p. motors.

CAPACITY: 132 pounds (oven-dry) solids per minute.

FUNCTION: Receives input from barrel thickeners and further dewaters the process stream to approximately 40 percent solids. The rejects enter the whitewater system.

20. FLUID BED INCINERATOR

LOCATION: Hydrasposal "B" Subsystem (separate reactor room)

MANUFACTURER: Dorr-Oliver, Incorporated

DESCRIPTION: The reactor is 21 ft. in diameter, of fluid-bed design. The reactor can sustain autogenous burn with a minimum input calorific value of 3000 BTU/lb. The input is a mixture of fibrous material and municipal sludge of approximately 40% solids. The volatile solids content on a dry weight basis is approximately 90 percent. The bed temperature is maintained at approximately 1500°F.

CAPACITY: 132 pounds/minute of the mixture described above. (approx. 1.0×10^6 BTU/min.)

FUNCTION: Ultimate disposal by incineration of rejects from Fiber Recovery System, pre-thickened materials using the Fiber Recovery System, or the liquid cyclone process streeam. The reactor is also capable of incinerating liquid industrial wastes.

21. VENTURI SCRUBBER

LOCATION: Hydrasposal "B" Subsystem

MANUFACTURER: Dorr-Oliver, Incorporated

DESCRIPTION: Cools 71,800 cfm of combustion gases from 1570°F to 182°F by introduction of 81.5 gpm of water. Ash removal by discharging 30 gpm of water from the scrubber system.

FUNCTION: Removes particulate matters from combustion gases at approximately 99% effectiveness, using city water in scrubber.

22. WHITEWATER TANK - SMALLER, OUTDOOR

LOCATION: Outside, Southeast corner.

DESCRIPTION: Constructed of A 36, commercial grade HRS, with capacity of 10,000 gallons. Field-welded and sandblasted, epoxy-painted.

FUNCTION: Receives input from Fiber Recovery System dewatering section and pumps the whitewater to the common whitewater system.

23. WHITEWATER CHEST - LARGER, OUTDOOR

LOCATION: Next to surge chest at Southwest end of building

DESCRIPTION: Constructed of A 36, commercial grade HRS, with capacity of 30,000 gallons.

FUNCTION: Receives input from Hydrasposal "B" Subsystem, dewatering section, provides for storage and recycling of whitewater to hydrapulper.

24. SLUDGE CHEST

LOCATION: East of large, whitewater chest on South side of plant.

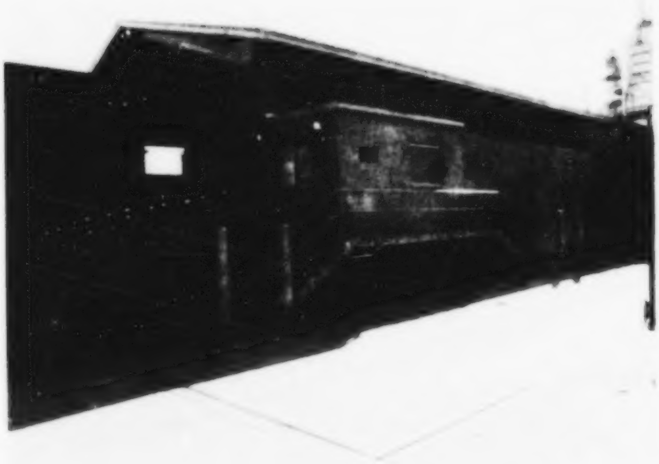
DESCRIPTION: Constructed of A 36, commercial grade HRS, with capacity of 45,000 gallons.

FUNCTION: Receives sludge from MCD and allows for uniform feed to Rietz Cone Press.

APPENDIX B

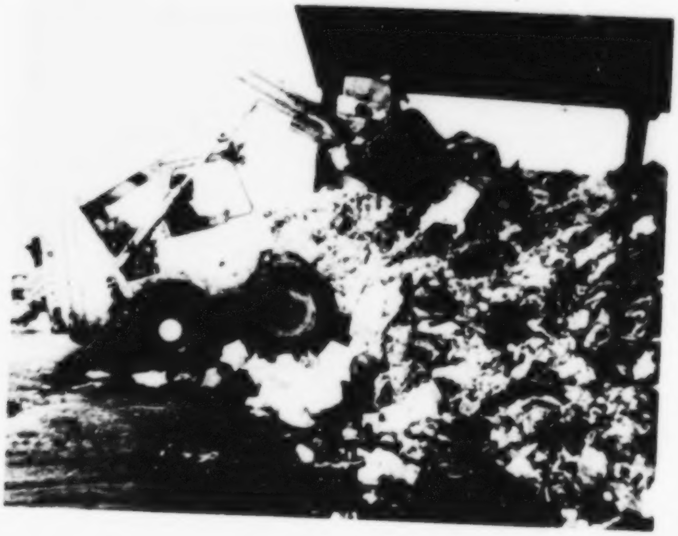
PICTORIAL FLOW DIAGRAMS

This section presents a pictorial flow diagram with which the reader can visualize the various equipments used in the Franklin Plant. Section 3, Operational Capability describes the process flow and can be used to supplement this pictorial presentation.

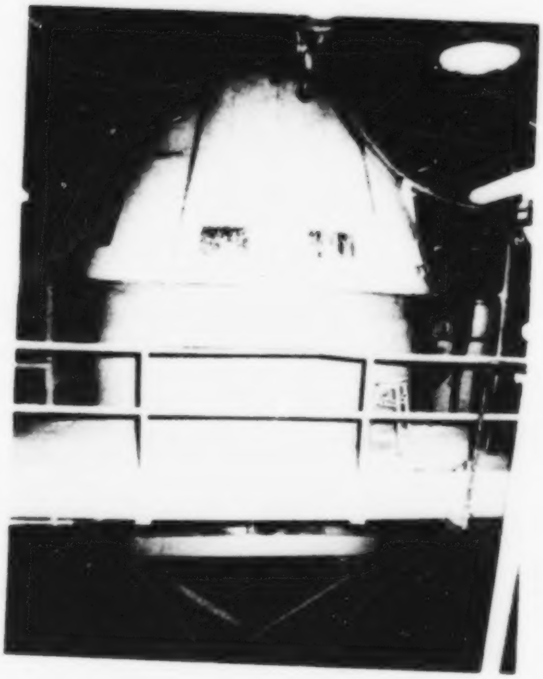


(1) Weighing Station and Apron

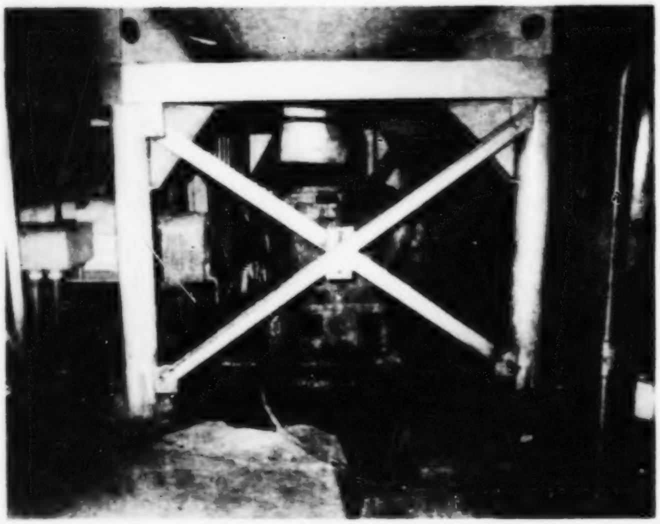
(2) Tipping Floor



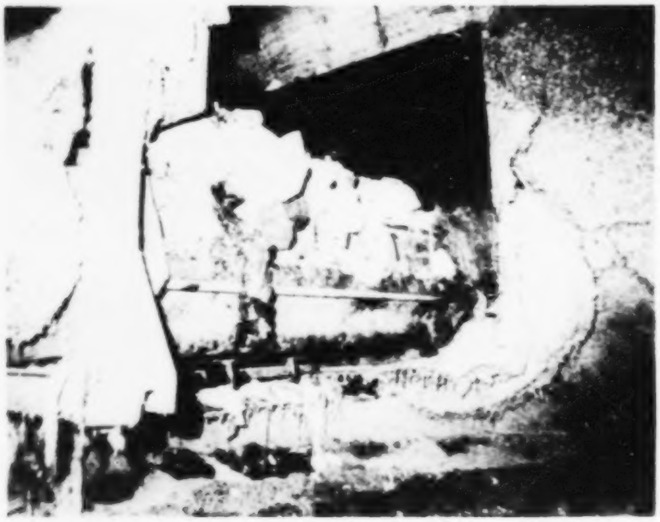
(3) Operator Using "Bobcat" on Tipping Floor to Move Solid Waste to Conveyor



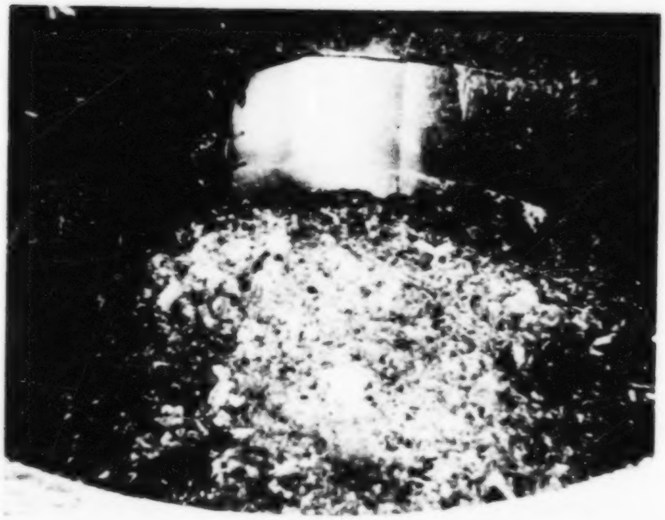
(4) Exterior View of Hydrapulper



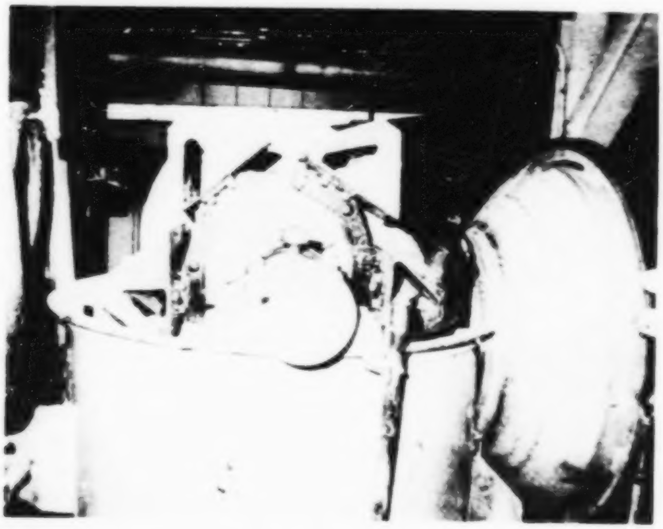
(5) Base of Hydrapulper Illustrating Motor/Drive System



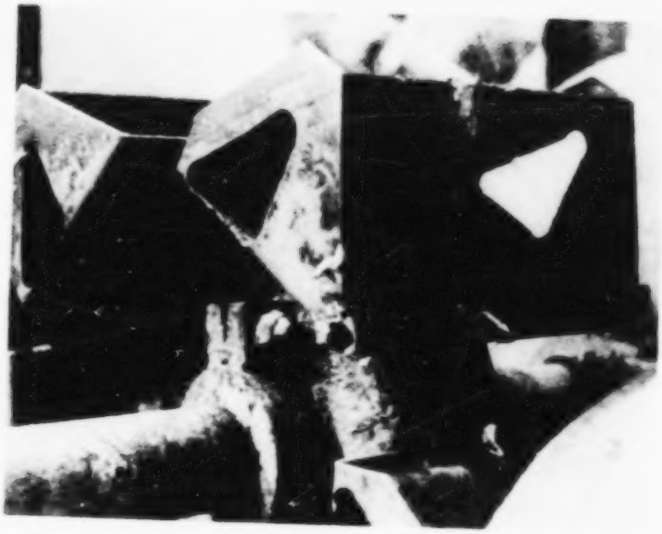
(6) Conveyor Feed Entering Hydrapulper
(Interior View)



(7) Hydrapulper Interior Illustrating Macerated Solid Waste (not operating)

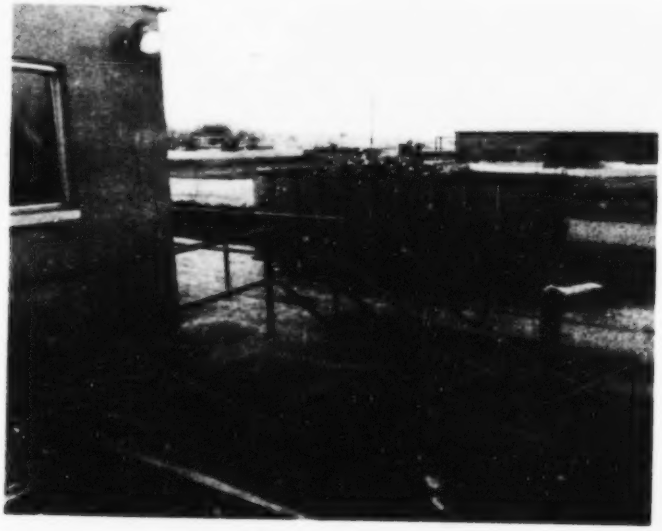


(8) Side View of Upper Portion of Junk Remover Illustrating Bucket Assembly. Portion of Junk Washer Seen at Right.

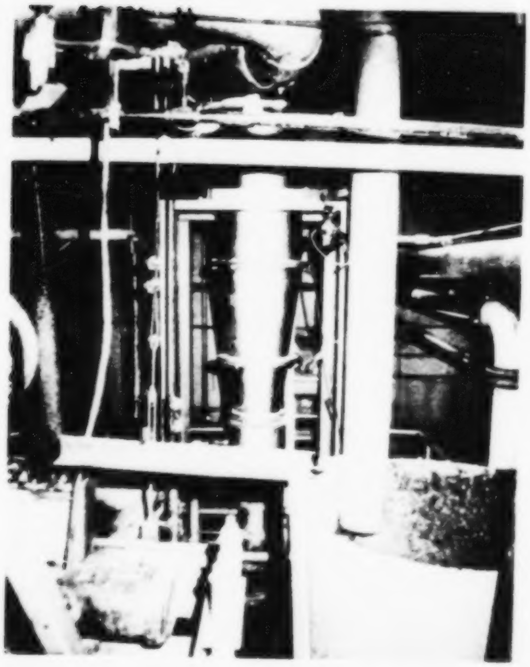


(9) Close-up View of Junk Remover Buckets

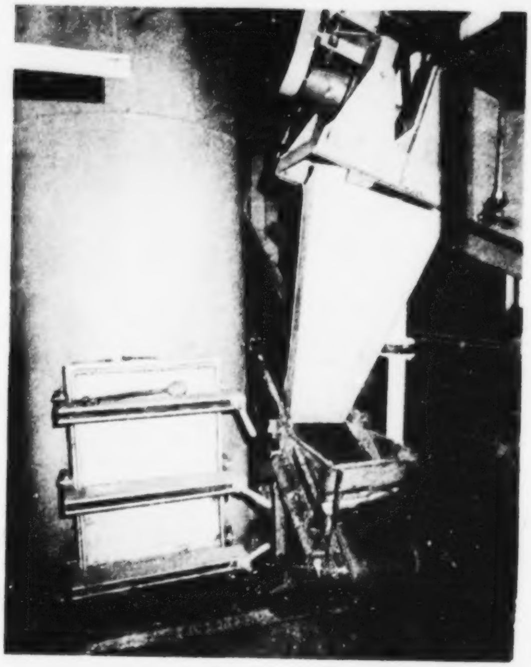
(10) Magnetic Separator - Magnetics are carried to Bin at Right while Non-Magnetics fall into container on left.



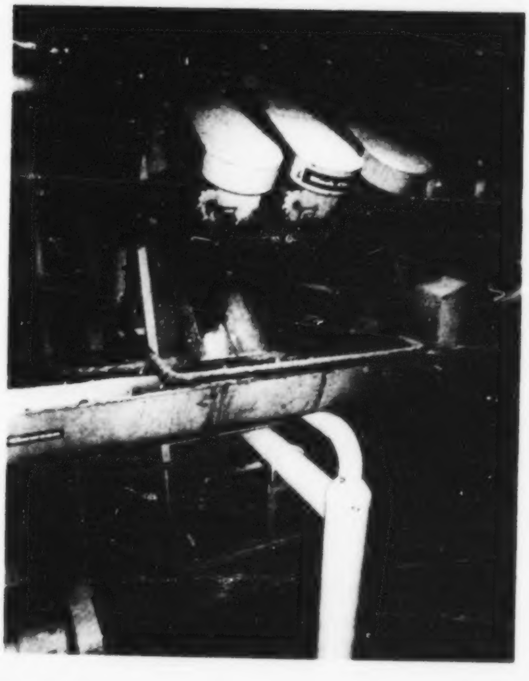
(11) Magnetic Hopper - Magnetics bin is emptied into this container for subsequent transport to processor.



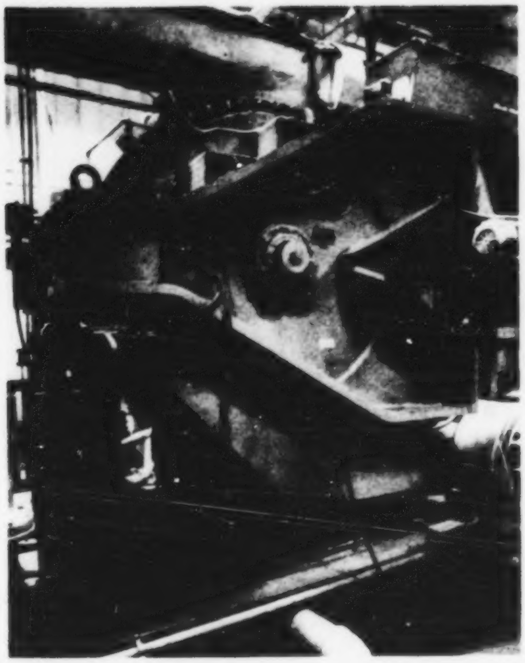
(12) Liquid Cyclone



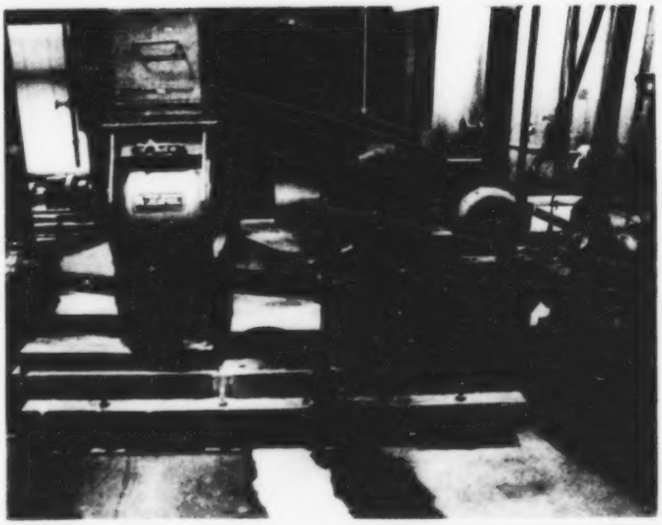
(13) Conveyor to Glass Plant



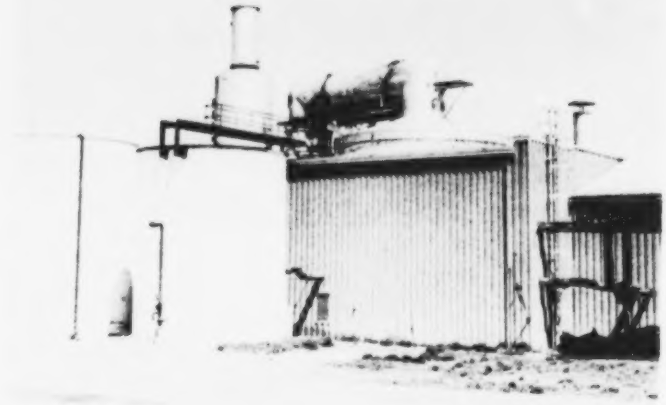
(14) Barrel Thickeners in Dewatering and Incineration Susbystem



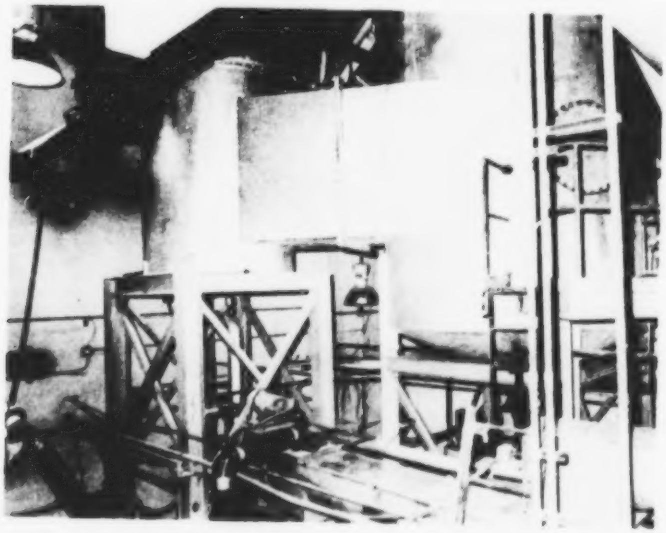
(15) Rietz Cone Press
(Dewatering and
Incineration Subsystem)



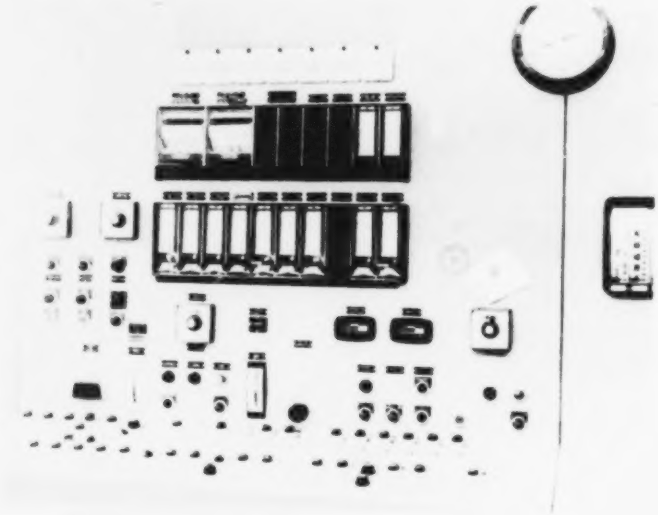
(16) Pneumatic Feed (Dewatering and Incineration
Subsystem) to Fluid Bed Reactor



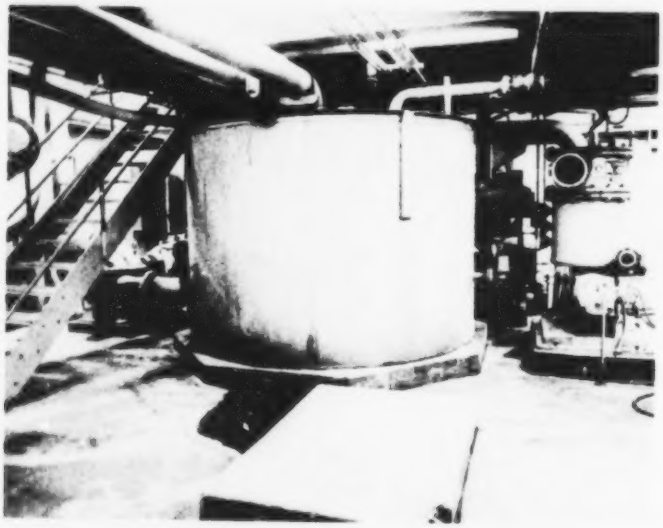
(17) Exterior View of Fluid Bed Reactor - Tanks at Left Are (L to R) Surge Chest and Sludge Chest



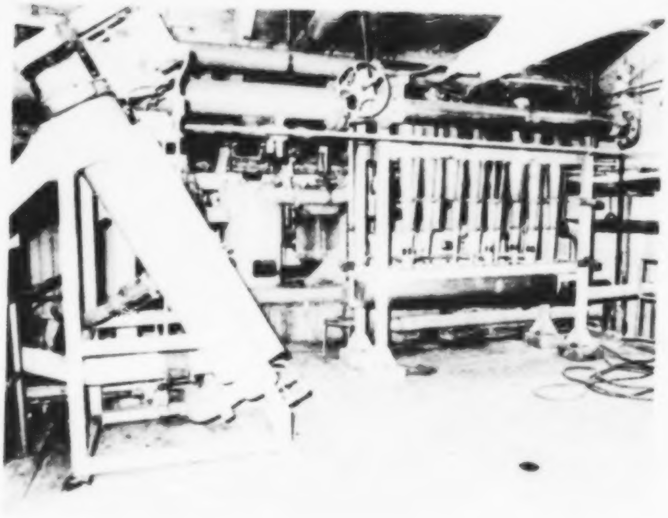
(18) Venturi Scrubber (D & I Subsystem)



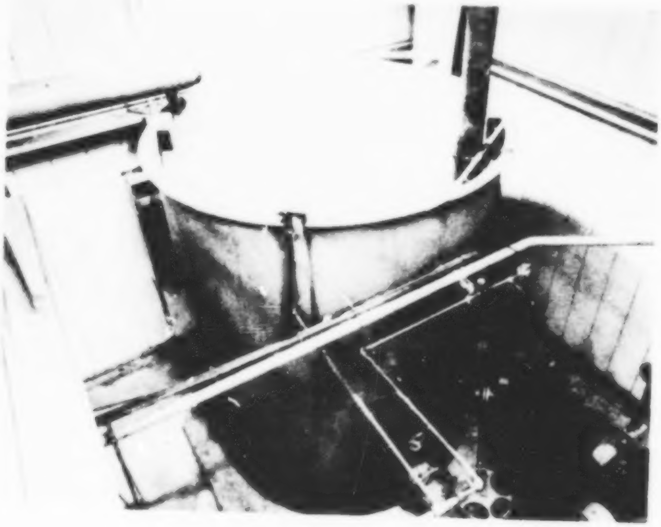
(19) Control Panels for Pulping and Separation, and Dewatering and Incineration Subsystems.



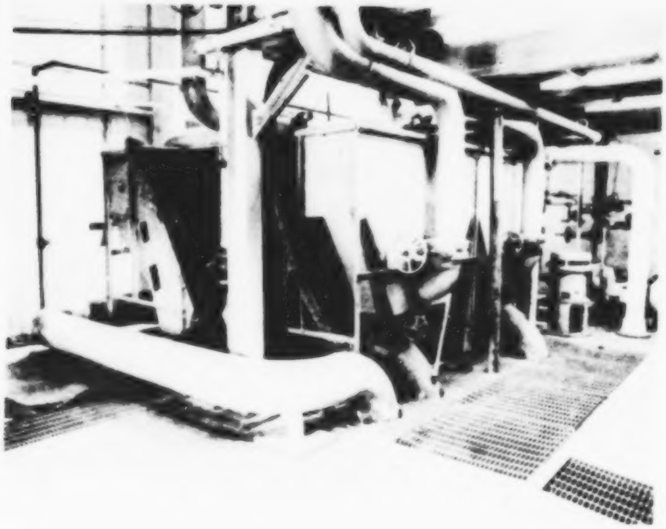
(20) Selectifier Dilution Tank



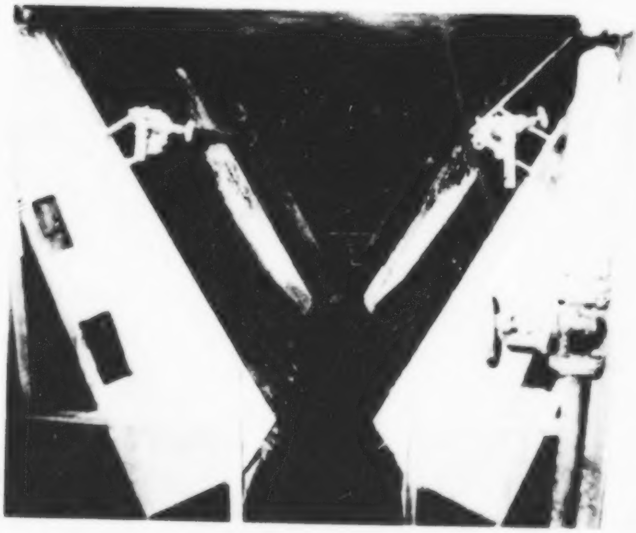
(21) Fiber Recovery System - Mezzanine
Left - Barrel Thickener
Center Rear - Selectifier
Right - Centrifugal Cleaners Assembly



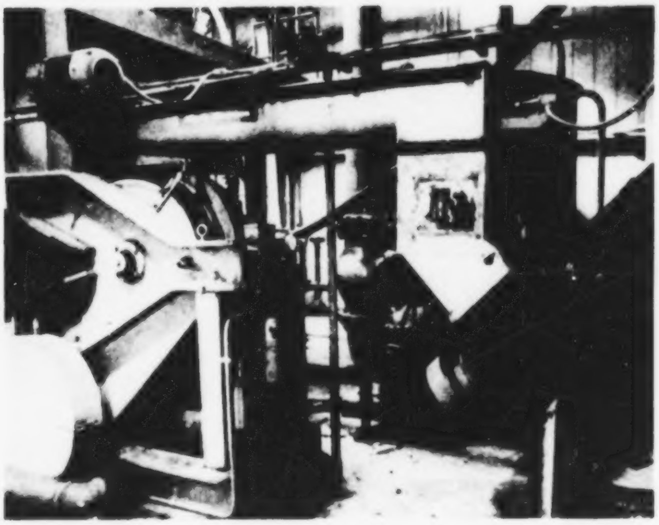
(22) Cleaners Supply Tank



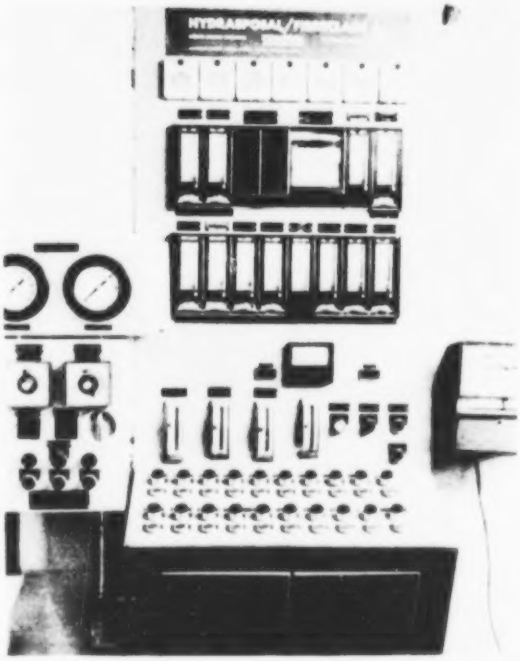
(23) Rundown Screens Assembly



(24) Rundown Screens - (Detail) - Operational



(25) Fiber Thickening and Recovery
Left - Cone Press
Center Top - Overhead Conveyor
Right - Screw Conveyor To Fiber Chest



(26) Control Panel -
Fiber Recovery

APPENDIX C

MATERIAL BALANCE SHEETS AND DATA COMPILATION FORMS

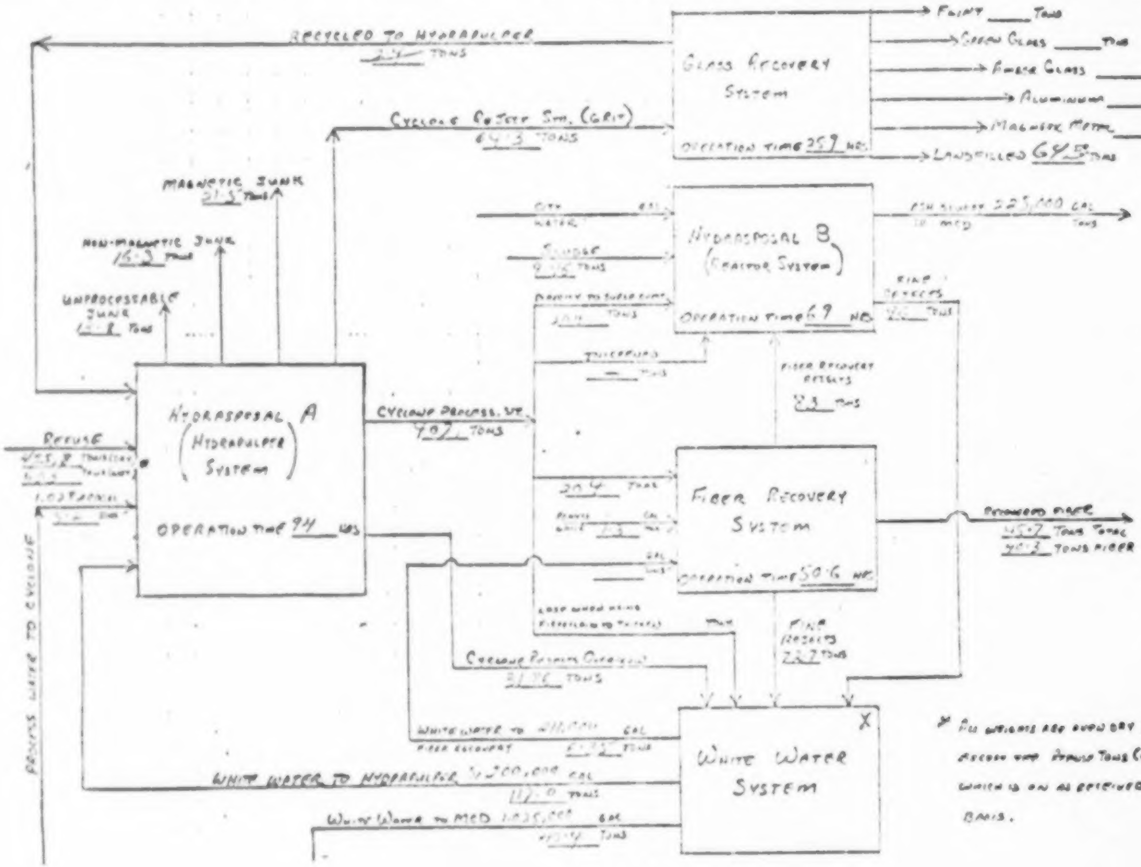
(COMPILED DAILY AND PRESENTED AS
4-WEEK TOTALS)

APPENDIX	DATE
C-1	7 JAN - 2 FEB, 1974
C-2	4 FEB - 2 MAR, 1974
C-3	4 MAR - 23 MAR, 1974
C-4	25 MAR - 20 APR, 1974
C-5	22 APR - 18 MAY, 1974
C-6	20 MAY - 15 JUN, 1974

APPENDIX C-1

7 JAN - 2 FEB, 1974

FRANKLIN SOLID WASTE REDUCTION PLANT – MATERIAL BALANCE DIAGRAM – TOTAL PLANT DATE 7 JAN – 8 FEB. 7[illegible]


RECYCLED TO HYDRAPULPER
TONS
CYCLONE REJECT STM. (GRIT)
64.3 TONS
GLASS RECOVERY SYSTEM
OPERATION TIME 25.9 HRS.
FLINT ____ TONS
GREEN GLASS ____ TONS
AMBER GLASS ____ TONS
ALUMINUM ____ TONS
MAGNETIC METAL ____ TONS
LANDFILLED 64.5 TONS
MAGNETIC JUNK
21.5 TONS
NON-MAGNETIC JUNK
16.3 TONS
UNPROCESSABLE JUNK
TONS
CITY WATER GAL
SLUDGE
TONS
TONS
THICKENED
— TONS
HYDRASPOSAL B
(REACTOR SYSTEM)
OPERATION TIME 6.9 HRS
TO SEWER 225,000 GAL
TO MCD
TONS
FINE REJECTS
TONS
FIBER RECOVERY REJECTS
2.3 TONS
REFUSE
TONS (DRY)
TONS (WET)
TONS
HYDRASPOSAL A
(HYDRAPULPER SYSTEM)
OPERATION TIME 94 HRS
CYCLONE PROCESS. ST.
TONS
TONS
GAL
TONS
GAL
TONS
FIBER RECOVERY SYSTEM
OPERATION TIME 50.6 HRS.
RECOVERED FIBER
45.7 TONS TOTAL
40.3 TONS FIBER
LOST WHEN BEING
TONS
FINE REJECTS
22.7 TONS
CYCLONE PROCESS OVERFLOW
TONS
WHITE WATER TO FIBER RECOVERY
GAL
TONS
WHITE WATER TO HYDRAPULPER
GAL
TONS
WHITE WATER TO MCD
GAL
TONS
WHITE WATER SYSTEM
X
PROCESS WATER TO CYCLONE

* All weights are oven dry basis except [illegible] tons (wet) which is on as received basis.

Franklin Solid Waste Reduction Plant - Material Balance - Hydrasposal Subsystem A   Date 7 Jan - 2 Feb 74

Date	Wet Weights: Refuse as Received, Moisture Content (%)	Wet Weights: Refuse as Received, Wet Weight (Tons)	Wet Weights: Pulper Input, Wet Weight (Tons)	Wet Weights: Nonpulpable [illegible], Weight (Tons)	Inputs: Pulper Input, Dry Weight (Tons)	Inputs: [illegible], Dry Weight (Tons)	Inputs: Fibers Lost [illegible], Dry Weight (Tons)		Outputs: Nonmagnetic Junk, Dry Weight (Tons)	Outputs: Magnetic Junk, Dry Weight (Tons)	Outputs: Cyclone Rejects, Dry Weight (Tons)	Outputs: Cyclone [illegible], Dry Weight (Tons)	Outputs: Cyclone [illegible], Dry Weight (Tons)
[illegible]		31.2	[illegible]	0.2	21.4	[illegible]	.36		1.00	2.20	2.10	23.0	1.32
[illegible]		37.6	37.5	—	24.9	10.1	.49		.90	2.92	2.41	27.4	1.80
[illegible]		20.0	19.5	0.5	13.2	[illegible]	.25		.50	2.10	2.91	11.6	.72
[illegible]		[illegible]	21.8	—	17.0	[illegible]	.29		.63	2.30	2.70	17.2	1.02
[illegible]		[illegible]	24.6	[illegible]	17.6	[illegible]	.23		1.13	2.11	3.30	16.2	.56
Weekly Total	39.1%	[illegible]	[illegible]	0.4	94.2	[illegible]	1.39		4.13	12.4	14.7	95.5	5.72
[illegible]		—	—	—	—	—	—		—	—	—	—	—
[illegible]		[illegible]	[illegible]	[illegible]	24.1	[illegible]	.11		1.17	2.25	1.92	29.5	4.76
[illegible]		[illegible]	31.4	0.7	21.5	10.3	.12		.17	3.00	2.66	21.1	3.46
[illegible]		[illegible]	11.3	[illegible]	[illegible]	[illegible]	.17		.27	1.00	1.32	4.71	.34
[illegible]		51.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		1.34	4.24	5.93	[illegible]	3.24
Weekly Total	35.2%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		3.75	12.1	11.7	[illegible]	11.8
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.12		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		22.2	21.2	1.0	[illegible]	[illegible]	.22		.73	1.70	2.90	[illegible]	—
[illegible]		15.3	14.8	0.5	[illegible]	[illegible]	.15		—	1.30	1.11	[illegible]	.92
[illegible]		45.2	[illegible]	3.5	[illegible]	[illegible]	.78		1.21	[illegible]	3.35	22.2	1.92
[illegible]		—	—	—	—	—	—		—	—	—	—	—
Weekly Total		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	12.7	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	1.1	[illegible]	[illegible]	.49		1.29	4.33	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	1.2	[illegible]	[illegible]	.26		.72	1.81	5.51	25.4	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.29		[illegible]	2.31	4.65	23.9	2.01
[illegible]		47.6	[illegible]	1.7	[illegible]	[illegible]	[illegible]		1.41	2.25	[illegible]	[illegible]	[illegible]
[illegible]		41.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		1.12	[illegible]	[illegible]	[illegible]	[illegible]
Weekly Total		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.71		[illegible]	12.4	25.6	[illegible]	10.4
Period Totals	avg 31.65	632.6	467.3	13.8	442.0	117.0	5.2		16.35	41.5	64.3	407.1	31.86

Franklin Solid Waste Reduction Plant - Material Balance - Hydrodisposal Subsystem B (Dewatering + Reactor Sections) Date 7 Jan - 2 Feb 74

DATE	INPUTS TO SURGE CHEST FROM OTHER SYSTEMS				DEWATERING SECTION						REACTOR SECTION
					INPUTS		TOTAL	OUTPUTS			
	Cyclone [illegible]	Plastic Sep. [illegible]	Fiber Recovery Rejects	TOTAL	SURGE CHEST OUTPUT	SLUDGE CHEST OUTPUT	MATERIAL IN SECTION	Thickener Product Stream	Cone Press Reject Stream	Cone Press Product Stream	OUTPUT [illegible] SEWER FROM REACTOR
Day Mo	Dry wt (tons)	Dry wt (tons)	Dry wt (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry wt. (tons)
7 Jan	23.0	-	-	23.0	17.4	—	17.4	7.58	.29	9.58	
8 "	27.4	-	-	27.4	31.5	.02	31.5	14.5	.56	16.4	
9 "	11.6	-	-	11.6	13.2	—	13.2	6.12	.21	6.49	
10 "	17.2	-	-	17.2	21.4	—	21.4	5.93	.27	15.2	
11 "	16.2	-	-	16.2	18.6	—	18.6	5.46	.27	12.9	
12 "	—	-	-	—	est 5.3	—	est 5.3	est 2.1	est .08	est 3.1	
Weekly Totals	95.5	-	-	95.5	107.	.02	107.	41.9	1.68	63.9	
14 Jan	—	-	-	—	—	—	—	—	—	—	
15 "	28.5	-	-	28.5	22.9	—	22.9	9.20	.40	18.3	
16 "	21.1	-	-	21.1	17.4	—	17.4	7.10	.35	10.6	
17 "	4.71	-	-	4.71	7.74	—	7.74	1.99	.08	5.67	
18 "	40.2	-	-	40.2	19.9	.22	20.1	5.54	.29	13.9	
19	—	-	-	—	3.14	—	3.14	est 1.24	est .25	2.05	
Weekly Totals	94.5			94.5	76.1	.22	76.3	25.3	1.17	49.9	
21 Jan	.46	—	9.74	10.2	8.69	.55	9.25	1.80	.16	7.29	
22 "	.10	—	5.13	5.23	6.09	.42	6.51	1.47	.16	4.88	
23 "	—	—	4.56	4.56	2.29	.15	2.44	est .54	est .05	1.85	
24 "	3.15	-	9.52	11.7	10.4	1.50	11.9	2.38	.19	9.37	
25 "	—	—	—	—	—	—	—	—	—	—	
26	—	—	—	—	4.12	—	4.12	est .71	est .06	3.35	
Weekly Totals	3.71	—	29.0	31.7	31.52	2.62	34.2	6.9	~~.62~~	26.74	
28 Jan	9.70	—	9.24	18.9	13.8	1.73	15.6	3.72	.26	11.5	
29 "	—	—	12.9	12.9	11.4	.78	12.2	2.69	.23	9.24	
30 "	.76	—	7.77	8.53	8.45	1.70	10.2	2.52	.26	9.37	
31 "	—	—	12.9	12.9	12.2	.79	13.0	3.10	.25	9.61	
1 Feb	—	—	12.0	12.0	10.6	1.55	12.2	3.00	.26	8.95	
2 "	—	—	—	—	5.90	.54	6.44	est [illegible]	est [illegible]	4.76	
Weekly Totals	10.46		54.8	65.2	62.3	7.1	69.6	16.6	1.57	51.4	
	20.46										
Period Totals	204.2		82.8	286.9	276.9	9.96	287.1	90.6	4.97	191.9	

Franklin Solid Waste Reduction Plant - Material Balance - Fiber Recovery System DATE 7 Jan - 1 Feb 74

Date	INPUTS				OUTPUTS						
	Cyclone Process Stream	White Water	Process Water	Total Inputs	Total Output	Selectifier Reject Stream	[illegible]	Ran-Down Screen Reject Stream	Thickener + Press [illegible]	Recovered Fiber Total Solids	Recovered Fiber Fiber Only
Day Mo	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)
7 Jan	—	—	—	—	—	—	—	—	—	—	—
8 "	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	—
11 "	—	—	—	—	—	—	—	—	—	—	—
[illegible]	—	—	—	—	—	—	—	—	—	—	—
14 Jan	—	—	—	—	—	—	—	—	—	—	—
15 "	—	—	—	—	—	—	—	—	—	—	—
16 "	—	—	—	—	—	—	—	—	—	—	—
17 "	—	—	—	—	—	—	—	—	—	—	—
18 "	—	—	—	—	—	—	—	—	—	—	—
[illegible]		—	—	—	—	—	—	—	—	—	—
21 Jan	19.1	—	.16	19.26	19.69	8.55	1.09	5.31	.73	3.31	2.91
22	10.7	—	.12	10.82	9.22	4.73	.40	1.21	.52	2.86	2.52
23 "	9.47	—	.06	9.53	8.33	4.11	.45	1.11	.25	2.41	2.12
24 "	23.0	1.40	.11	24.51	21.96	7.24	1.28	5.64	1.77	7.93	6.79
25 "	—	—	—	—	—	—	—	—	—	—	
[illegible]	62.27	1.40	.41	64.12		24.73	3.22	13.27	3.33	16.51	14.5
[illegible]	29.0	—	.16	29.16	28.62	6.70	2.54	10.8	1.16	7.42	6.53
[illegible]	28.4	1.59	.14	29.13	26.47	12.0	.91	6.79	1.02	5.75	5.1
[illegible]	21.0	1.09	.12	22.21	24.91	6.19	1.58	12.1	.56	4.47	3.94
[illegible]	34.9	.87	.27	36.04	31.82	9.48	3.44	11.6	.94	5.36	4.7
1 Feb	29.9	[illegible]	.20	[illegible]	29.41	9.28	2.74	9.95	1.23	6.21	5.5
[illegible]	141.2	4.95	.89	147.04	140.23	43.65	11.21	51.24	4.91	29.22	25.8
Period Totals	203.67	6.35	1.3	211.32	2013	68.38	14.43	64.51	8.24	45.73	40.3

72.7

WHITE WATER TO MCD WASTE WATER TREATMENT PLANT

DATE 7 JAN - 2 FEB, 74

V_{592} = VOLUME OF WHITE WATER TO MCD

= + TOTAL PROCESS WATER TO SOLID WASTE PLANT ________ 1,360,000 V_{610}

$(594115 - 507011)(122) + \left(\frac{[illegible]}{1,640}\right)(52)$

+ TOTAL MOISTURE IN REFUSE ________ 5,350 V_{249}

(TOTAL WET WT − TOTAL DRY WT) 240
464.3 − 442.0

− TOTAL WATER SENT TO LOCAN LAB WITH FIBER ________ 284,000 V_{246}

− TOTAL WATER INPUT TO REACTOR WITH REFUSE ________ 56,000 V_{244}

(TOTAL WT PRESS PRAC. STR.) 292
191.9

________ 1,025,000

________ V_{592}

W_{592} = DRY SOLIDS CONTENT OF WHITE WATER SENT TO MCD

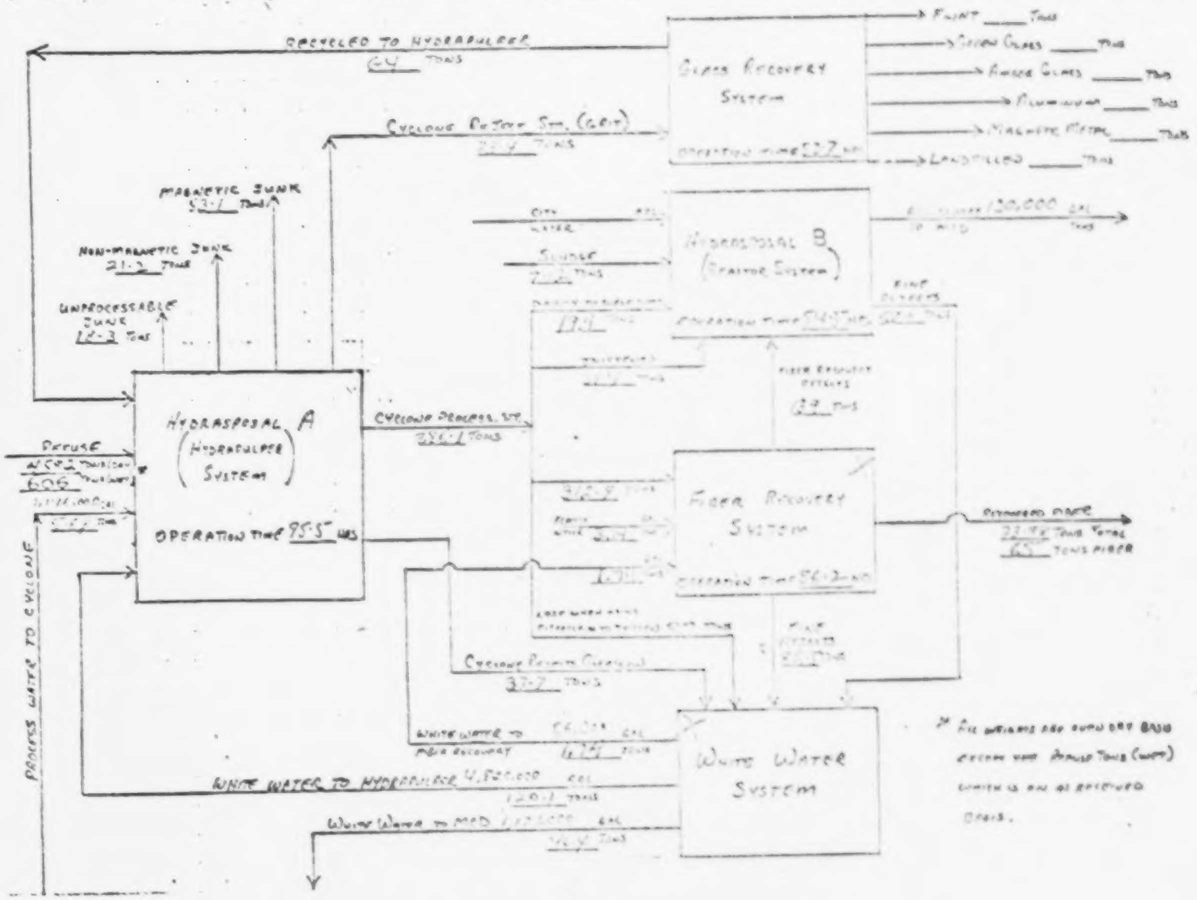
(gallons white water 1,025,000)(solids content % .945)(4.17×10^{-5}) = ________ 40.4 W_{592}

Reproduced from best available copy.

APPENDIX C-2

4 FEB - 2 MAR, 1974

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE DIAGRAM - TOTAL PLANT DATE 4 WKS. - 3 APR. 74


RECYCLED TO HYDRAPULPER
6.4 TONS
GLASS RECOVERY SYSTEM
OPERATION TIME 52.7 HRS
FLINT ___ TONS
GREEN GLASS ___ TONS
AMBER GLASS ___ TONS
ALUMINUM ___ TONS
MAGNETIC METAL ___ TONS
LANDFILLED ___ TONS
CYCLONE REJECT STR. (GRIT)
22.4 TONS
MAGNETIC JUNK
53.1 TONS
NON-MAGNETIC JUNK
21.2 TONS
UNPROCESSABLE JUNK
12.3 TONS
CITY WATER
SLUDGE
TONS
HYDRASPOSAL B
(REACTOR SYSTEM)
OPERATION TIME HRS
120,000 GAL
TO MSD
TONS
FINE REJECTS
TONS
FIBER RECOVERY REJECTS
TONS
HYDRASPOSAL A
(HYDRAPULPER SYSTEM)
OPERATION TIME 95.5 HRS
REFUSE
TONS (DRY)
606 TONS (WET)
PROCESS WATER TO CYCLONE
CYCLONE PROCESS ST.
TONS
FIBER RECOVERY SYSTEM
OPERATION TIME 56.2 HRS
TONS
PROCESS WATER
TONS
RECOVERED FIBER
TONS TOTAL
65 TONS FIBER
FINE REJECTS
TONS
CYCLONE REJECTS
37.7 TONS
WHITE WATER TO FIBER RECOVERY
GAL
TONS
WHITE WATER TO HYDRAPULPER 4,800,000 GAL
120.1 TONS
WHITE WATER TO MSD
GAL
TONS
WHITE WATER SYSTEM

* All weights are oven dry basis except the refuse tons (wet) which is on as received basis.

Reproduced from best available copy.

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE - HYDRASPOSAL SUBSYSTEM A DATE 4 FEB - 2 MAR

DATE	WET WEIGHTS				INPUTS				OUTPUTS				
	REFUSE AS RECEIVED		PULPER INPUT	[illegible]	PULPER INPUT	[illegible] TO PULPER	[illegible]		NONMAGNETIC JUNK	MAGNETIC JUNK	CYCLONE REJECTS	CYCLONE [illegible]	[illegible]
DAY MO.	MOISTURE CONTENT (%)	WET WEIGHT (TONS)	WET WEIGHT (TONS)	WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)		DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)
4 Feb		32.2	30.7	1.5	24.5	[illegible]	.33		.74	2.18	3.72	22.5	2.65
5 ·		23.0	23.0	—	17.6	5.2[illegible]	.29		1.06	2.16	4.72	14.1	1.39
6 ·		22.5	22.3	0.2	15.[illegible]	3.[illegible]	.20		—	.35	3.59	14.0	1.64
7 ·		23.9	23.2	0.7	20.0	4.[illegible]	.29		.46	2.98	2.64	15.3	2.74
8 ·		32.8	32.6	0.2	22.[illegible]	3.2[illegible]	.30		1.25	3.10	4.25	21.0	1.86
WEEKLY TOTALS		142.4	139.8	2.6	[illegible]	28.[illegible]	1.4[illegible]		3.73	11.1	18.9	93.9	9.7
11 Feb		27.6	26.1	1.5	[illegible]	5.[illegible]	.24		1.22	1.39	3.43	14.9	2.62
12 ·		29.0	28.0	1.0	20.3	3.49	.27		1.06	2.62	4.29	22.2	1.25
13 ·		24.1	23.6	0.5	20.9	3.72	.19		.79	1.71	5.13	14.8	2.54
14 ·		40.5	39.5	1.0	31.2	[illegible]	.39		1.41	3.54	4.65	23.6	2.72
15 ·		38.5	37.5	1.0	23.5	5.[illegible]	.32		1.47	4.[illegible]	5.1[illegible]	22.4	2.64
WEEKLY TOTALS		159.7	154.7	5.0	123.2	20.3	1.51		5.97	14.1	22.9	100.8	11.8
18 Feb		27.1	25.9	1.2	17.7	2.96	.24		.94	2.79	2.21	14.[illegible]	3.38
19 ·		26.3	25.8	0.5	17.4	8.13	.27		1.31	2.65	2.54	18.2	3.24
20 ·		32.3	31.3	1.0	26.7	8.5[illegible]	.35		1.34	3.10	3.24	25.2	1.49
21 ·		40.5	38.0	2.5	29.7	8.22	.34		1.41	4.20	5.49	26.2	1.91
22 ·		32.2	31.0	1.2	20.3	6.[illegible]	.28		1.14	2.82	3.06	17.8	2.86
WEEKLY TOTALS		158.4	152	6.4	[illegible]	34.3	1.41		5.41	16.3	17.06	101.8	10.62
25 Feb		22.1	16.6	5.5	[illegible]	2.2[illegible]	.18		.96	2.10	1.21	11.4	.78
26 ·		32.9	32.2	0.5	21.2	5.41	.29		.94	1.78	2.58	27.3	1.93
27 ·		22.7	22.2	0.5	16.1	3.[illegible]	.17		1.00	1.32	2.31	15.3	1.86
28 ·		39.0	38.2	1.2	21.8	8.[illegible]	.38		1.52	3.10	3.89	20.4	1.38
1 Mar		31.3	30.3	1.0	21.8	6.24	.30		1.35	2.56	3.64	22.2	—
WEEKLY TOTALS		145.8	141.5	4.2	95.5	31.0	1.32		5.6	11.62	14.6	95.6	5.6
PERIOD TOTALS	30% Ave	606.3	588.0	18.3	437.9	180.1	5.64		21.2	53.1	73.4	386.1	37.7

FRANKLIN SOLID WASTE [illegible] PLANT - MATERIAL BALANCE - HYDRAULIC SUBSYSTEM B DATE 4 FEB – 2 MAR
([illegible] SECTION)

DATE	INPUTS TO SURGE CHEST FROM OTHER SECTIONS				DEWATERING SECTION INPUTS		TOTAL MATERIAL IN SECTION	OUTPUTS			[illegible] SECTION OUTPUT
	[illegible]	[illegible]	FIBER [illegible]	TOTAL	SURGE CHEST OUTPUT	[illegible] CHEST OUTPUT		THICKENER [illegible] STREAM	CONE PRESS [illegible] STREAM	CONE PRESS [illegible] STREAM	[illegible]
[illegible]	[illegible] (TONS)	[illegible] (TONS)	[illegible] (TONS)	[illegible] (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	[illegible] (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	[illegible] (TONS)
4 FEB	7.55	—	4.63	12.2	5.40	1.67	7.07	2.46	.10	6.11	
5 "	—	—	6.30	6.30	6.17	.24	6.41	2.52	.16	5.90	
6 "	—	—	6.16	6.16	5.22	.53	5.75	1.30	.07	4.38	
7 "	1.30	—	7.44	8.74	7.67	1.47	9.14	1.35	.20	6.53	
8 "	1.90	18.2	—	20.1	15.6	1.20	[illegible]	2.42	.22	13.9	
9 "	—	—	—	—	5.90	.33	6.23	[illegible]	[illegible]	5.34	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.87	42.2	
11 FEB	—	—	11.8	11.8	8.50	.31	8.81	1.30	.10	7.41	
12 "	—	—	8.24	8.24	9.25	.73	9.98	1.70	.17	6.11	
13 "	—	—	5.15	5.15	5.65	.19	5.84	1.27	.08	4.49	
14 "	.20	—	13.6	13.8	12.6	.09	12.7	2.65	.15	9.94	
15 "	.06	—	14.0	14.1	14.4	.03	14.4	2.93	.19	11.4	
16 "	—	—	—	—	6.57	—	6.57	[illegible]	[illegible]	5.14	
WEEKLY TOTALS	.26		[illegible]	[illegible]	52.9	[illegible]	[illegible]	10.6	.79	42.5	
18 FEB	1.85	—	6.48	8.33	3.08	.06	3.14	.71	.03	2.40	
19 "	1.16	—	7.73	8.89	7.18	—	7.18	1.59	.09	5.20	
20 "	2.52	—	6.41	8.93	10.3	—	10.3	2.58	.15	7.53	
21 "	—	—	12.3	12.3	13.0	.23	13.2	3.42	.18	9.65	
22 "	—	—	7.76	7.76	7.68	.96	8.64	2.44	.14	6.06	
23 "	—	—	—	—	4.74	—	4.74	1.23	.07	3.44	
WEEKLY TOTALS	5.4		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.3	.66	34.3	
25 FEB	—	8.73	.700	9.43	5.46	—	5.46	1.78	.07	3.61	
26	.48	19.3	—	19.8	13.1	—	13.1	3.70	.19	9.21	
27	—	—	5.74	5.74	11.8	—	11.8	3.33	.14	8.38	
28	.37	—	11.1	11.5	7.15	.01	7.16	2.27	.07	4.82	
1 MAR	2.22	4.38	3.71	10.3	10.7	.01	10.7	4.48	.23	6.01	
2 "	—	—	—	—	5.08	—	5.08	1.67	.30	3.31	
WEEKLY TOTALS	3.07	[illegible]	[illegible]	51.8	53.3	[illegible]	[illegible]	17.2	.8	35.3	
PERIOD TOTALS	19.43	51.4	[illegible]	210.8	204.3	7.12	211.8	54.0	3.12	154.3	

Franklin Solid Waste Reduction Plant - Material Balance - Fiber Recovery System   DATE 4 Feb - 2 Mar 78

Date	INPUTS				OUTPUTS						
	Cyclone Process Stream	White Water	Plastics Waste	Total Inputs	Total Output	[illegible] Reject Stream	[illegible] System	Run-Down Screen Reject Stream	Thickener & Fiber [illegible]	Recovered Fiber Total Stream	Recovered Fiber Fiber Only
Day Mo	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)
4 Feb	14.9	.21	.1	15.22	12.37	3.68	1.56	4.89	.55	2.31	2.03
5 "	14.7	—	.20	14.9	14.43	5.33	1.03	2.78	.94	4.55	4.0
6 "	14.2	—	.13	14.33	[illegible]	5.26	.80	4.13	.29	2.76	2.5
7 "	15.0	—	.17	15.17	[illegible]	6.50	.94	3.02	.58	3.21	2.8
8 "	—	—	—	—	—	—	—	—	—	—	—
Weekly Totals	58.8	.21	.66	59.67	54.6	25.17	4.32	14.82	2.36	12.83	11.3
11 Feb	14.9	—	.22	15.12	21.38	11.0	.82	3.94	.96	4.84	4.3
12 "	21.0	—	.18	21.18	17.22	9.30	.74	1.25	1.29	5.64	5.8
13 "	15.3	—	.15	15.45	11.29	5.09	.76	2.47	.49	2.91	2.6
14 "	23.4	—	.25	23.65	25.36	11.9	1.71	5.46	.29	6.40	5.6
15 "	22.9	—	.25	[illegible]	[illegible]	13.1	[illegible]	[illegible]	.79	5.91	5.2
Weekly Totals	102.3	—	[illegible]	[illegible]	[illegible]	47.39	[illegible]	16.53	3.31	26.7	23.5
18 Feb	12.7	.78	.13	13.51	16.91	5.27	1.21	6.30	.51	2.73	2.4
19 "	17.1	—	.13	17.23	[illegible]	6.82	1.11	3.92	.88	4.15	3.6
20 "	22.7	.31	.17	23.15	18.17	5.25	1.16	8.48	.94	3.69	3.2
21 "	26.5	.25	.22	26.97	[illegible]	11.0	1.20	7.01	1.58	5.67	5.0
22 "	18.1	—	.16	18.26	[illegible]	6.38	1.38	4.50	1.87	4.72	4.1
Weekly Totals	97.3	1.34	[illegible]	[illegible]	[illegible]	34.82	6.06	[illegible]	5.78	20.96	18.2
25 Feb	1.61	.19	.02	1.82	2.01	0.58 .58	.12	1.31	—	—	—
26 "	—	—	—	—	—	—	—	—	—	—	—
27 "	15.3	—	.13	15.43	11.49	5.18	.56	2.05	.52	3.18	2.80
28 "	23.2	—	.27	23.47	22.83	9.95	1.14	3.79	1.27	6.70	5.90
1 Mar	14.8	—	.15	14.95	[illegible]	2.34	1.37	5.48	.43	3.41	3.0
Weekly Totals	54.91	.19	.57	[illegible]	[illegible]	18.07	3.19	12.53	2.22	[illegible]	11.7
Period Totals	312.91	1.74	3.14	317.79	300.22	120.23	19.59	79.28	12.25	73.55	65.00

WHITE WATER TO MCD WASTE WATER TREATMENT PLANT

DATE 4FEB - 2MAR, 74

V_{592} = VOLUME OF WHITE WATER TO MCD

= + TOTAL PROCESS WATER TO SOLID WASTE PLANT 1,650,000 V_{680}
(395,770 − [illegible])([illegible]) + ([illegible])([illegible])

+ TOTAL MOISTURE IN REFUSE 35,500 V'_{178}
$\begin{pmatrix}\text{TOTAL WET WT} - \text{TOTAL DRY WT} \\ 588 - 439.7\end{pmatrix} 240$

− TOTAL WATER SENT TO LOGAN LAKE WITH FIBER 463,000 V_{316}

− TOTAL WATER INPUT TO REACTOR WITH REFUSE 45,100 V'_{209}
$\begin{pmatrix}\text{TOTAL WT PROCESSED} \\ 154.3\end{pmatrix} 292$

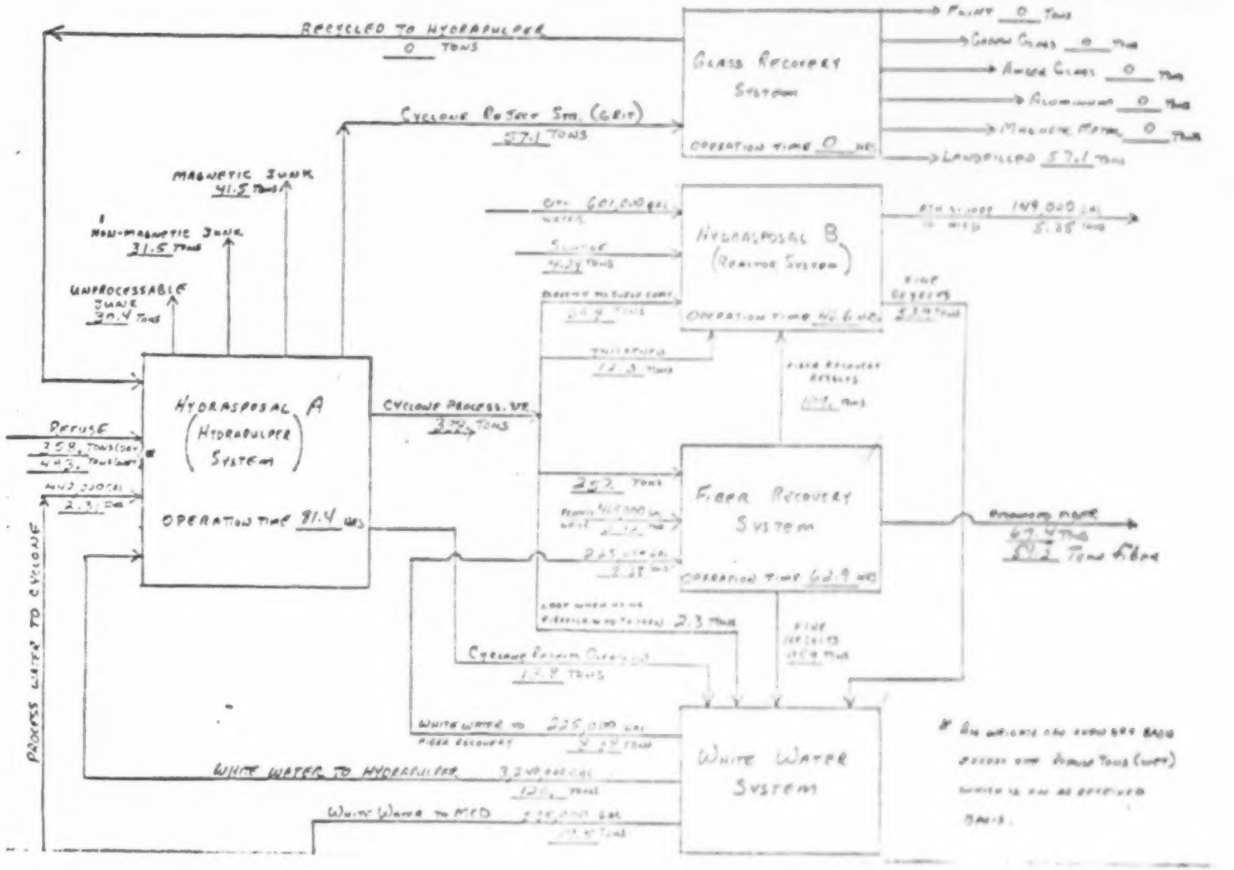
1,177,000 V_{592}

W_{592} = DRY SOLIDS CONTENT OF WHITE WATER SENT TO MCD
$\begin{pmatrix}\text{gallons white water} \\ 1,177,000\end{pmatrix}\begin{pmatrix}\text{solids content \%} \\ .945\end{pmatrix}(4.17 \times 10^{-5})$ = 46.4 W_{592}

APPENDIX C-3

4 MAR - 23 MAR, 1974

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE DIAGRAM - TOTAL PLANT   DATE 4-28 MARCH 74


RECYCLED TO HYDRAPULPER
0 TONS
GLASS RECOVERY SYSTEM
OPERATION TIME 0 HRS
FLINT 0 TONS
GREEN GLASS 0 TONS
AMBER GLASS 0 TONS
ALUMINUM 0 TONS
MAGNETIC METAL 0 TONS
LANDFILLED 57.1 TONS
CYCLONE REJECT STR. (GRIT)
57.1 TONS
MAGNETIC JUNK
41.5 TONS
NON-MAGNETIC JUNK
31.5 TONS
UNPROCESSABLE JUNK
30.4 TONS
HYDRASPOSAL A
(HYDRAPULPER SYSTEM)
OPERATION TIME 81.4 HRS
REFUSE
258. TONS (DRY)
443. TONS (WET)
2.31 TONS
PROCESS WATER TO CYCLONE
CYCLONE PROCESS. VR.
372. TONS
CITY WATER 601,000 GAL
SLUDGE
HYDRASPOSAL B
(REACTOR SYSTEM)
OPERATION TIME 46.6 HRS
TAILINGS
12.3 TONS
FINE REJECTS
5.35 TONS
FIBER RECOVERY REJECTS
FIBER RECOVERY SYSTEM
OPERATION TIME 62.9 HRS
252. TONS
2.3 TONS
FINE REJECTS
RECOVERED FIBER
67.4 TONS
TONS FIBER
CYCLONE REJECT OVERFLOW
17.8 TONS
WHITE WATER TO FIBER RECOVERY 225,000 GAL
WHITE WATER TO HYDRAPULPER 3,240,000 GAL
WHITE WATER TO MCD
WHITE WATER SYSTEM

* All weights are shown dry basis except the refuse tons (wet) which is on as received basis.

FRANKLIN SOLID WASTE REDUCTION PLANT - [illegible] - [illegible] SUBSYSTEM A DATE 4-23 March 74

DATE	WET WEIGHTS				INPUTS				OUTPUTS				
	REFUSE AS RECEIVED		PULPER OUTPUT	[illegible] JUNK	PULPER INPUT	[illegible]	[illegible]		[illegible] JUNK	MAGNETIC JUNK	CYCLONE REJECTS	CYCLONE [illegible]	[illegible]
DAY MO.	MOISTURE CONTENT (%)	WET WEIGHT (TON)	WEIGHT (TON)	WEIGHT (TON)	DRY WEIGHT (TON)	DRY WEIGHT (TON)	DRY WEIGHT (TON)		DRY WEIGHT (TON)	DRY WEIGHT (TON)	DRY WEIGHT (TON)	DRY WEIGHT (TON)	DRY WEIGHT (TONS)
4 Mar	35.2%	36.6	37.0	3.6	25.1	[illegible]	.12		2.09	2.18	3.15	20.2	—
5 "	21.5%	36.5	35.3	0.2	24.1	[illegible]	.15		1.35	2.76	1.10	22.9	—
6 "	27.9%	40.3	38.4	1.9	27.2	[illegible]	.16		2.40	2.97	4.12	25.5	1.32
7 "	26.0%	40.[illegible]	39.4	1.2	24.9	9.85	.16		0.57	2.49	3.10	26.1	1.29
8 "	30.1%	32.2	31.0	1.2	21.3	[illegible]	.14		1.31	3.39	4.4	22.3	—
WEEKLY TOTALS	28.2%	185.2	177.1	9.1	122.5	[illegible]	.72		9.63	14.8	21.9	114.4	2.55
11 Mar	22.1%	39.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	.18
12 "	27.7%	26.4	26.4	—	19.9	9.24	.07		2.12	.67	2.34	29.6	.09
13 "	41.2%	16.5	15.5	1.0	9.7	4.01	.03		1.54	1.00	2.21	9.21	.14
14 "	25.9%	28.2	26.9	1.3	20.0	12.9	.09		4.64	2.52	5.11	27.4	2.44
15 "	17.6%	47.8	46.[illegible]	1.2	38.2	14.3	[illegible]		4.08	4.45	6.44	39.4	4.44
WEEKLY TOTALS	25.4%	171.2	163.5	7.7	117.2	[illegible]	.42		15.4	14.5	19.9	125.	9.48
18 Mar	17.3%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		2.22	2.32	3.91	26.8	.61
19 "	18.2%	42.4	40.4	2.0	32.7	7.09	.10		2.86	3.90	5.64	31.4	—
20 "	22.9%	11.3	9.3	2.0	7.57	3.80	.04		1.39	.84	2.33	6.17	.71
21 "	26.4%	27.2	25.5	1.7	18.6	7.53	.11		1.77	2.24	2.49	21.5	—
22 "	23.2%	24.3	23.1	1.2	17.7	8.15	.14		1.64	2.44	2.86	19.8	—
WEEKLY TOTALS	23.1%	137.[illegible]	124.4	13.5	91.8	29.0	.52		9.45	12.4	[illegible]	96.1	1.34
WEEKLY TOTALS													
PERIOD TOTALS	AVG 27.4%	493.	463.	30.4	328.	120.	2.31		31.5	41.5	57.1	338.	13.8

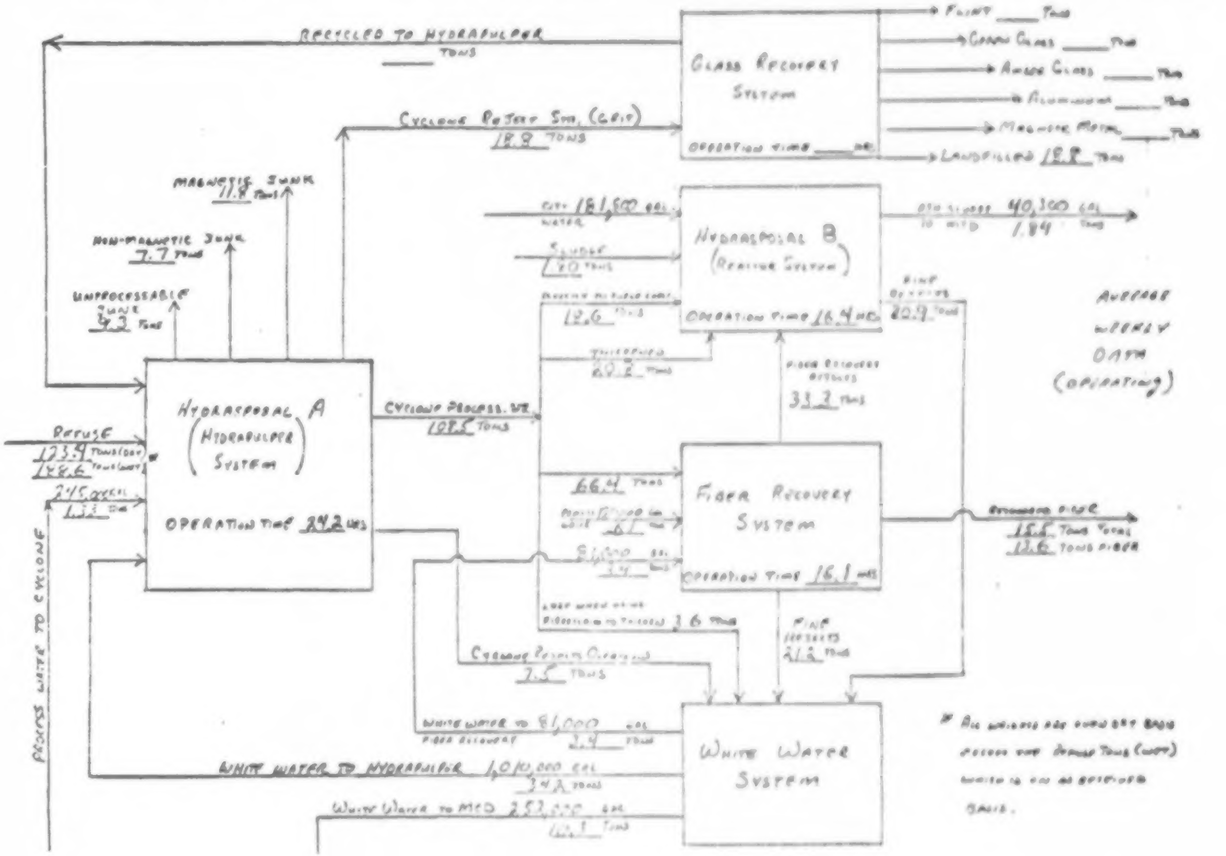
Franklin Solid Waste Reduction Plant - Material Balance - Hydrasposal Subsystem B Date 4-23 March 74
([illegible])

DATE	Inputs to Surge Chest from Other Systems				Dewatering Section Inputs		Total Material in Section	Outputs			[illegible] Section Output [illegible]
	Cyclone Rejects Sys [illegible]	[illegible]	Fiber Recovery System	TOTAL	Surge Chest Output	Sewage Chest Output		Thickener Primary Station	Cone Press Primary Station	Cone Press Secondary Station	
Day Mo	Dry wt (tons)	Dry wt (tons)	Dry wt (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry weight (tons)	Dry wt (tons)
4 Mar	2.59	—	6.59	9.17	4.89	—	4.89	1.45	.07	3.37	.15
5 "	—	—	8.95	8.95	11.3	—	11.3	3.28	.15	7.88	.31
6 "	—	—	9.02	9.02	6.73	—	6.73	2.18	.08	4.47	.35
7 "	.84	—	9.33	10.2	4.80	—	4.80	2.56	.09	2.15	.31
8 "	.33	—	12.8	13.1	13.7	—	13.7	3.17	.12	10.4	.46
9 "	—	—	—	—	5.71	—	5.71	1.62	.05	4.04	.16
Weekly Totals	3.75	—	46.7	50.4	52.1	—	52.1	14.3	.56	32.3	[illegible]
11 Mar	2.02	3.41	10.0	15.4	10.0	—	10.0	2.87	.08	7.07	.31
12 "	1.64	—	11.3	12.9	15.6	.18	15.8	3.14	.11	12.5	.23
13 "	—	—	5.29	5.29	4.36	—	4.36	1.48	.05	2.83	.15
14 "	8.58	—	6.98	15.6	13.0	.30	13.3	3.55	.25	9.50	.57
15 "	2.91	3.74	13.0	19.6	19.1	.19	19.3	7.38	.39	11.5	.65
16 "	—	—	—	—	7.96	.01	7.97	2.34	.11	5.52	.11
Weekly Totals	15.2	7.1	46.6	68.8	70.0	.68	70.7	20.8	.99	49.0	2.1
18 Mar	4.44	5.12	4.60	14.2	7.46	.03	7.49	1.84	.08	5.57	.1
19 "	22.4	—	2.71	25.1	16.3	1.01	17.3	4.77	.38	12.2	.31
20 "	—	—	3.94	3.94	7.80	.43	8.23	1.74	.18	6.31	.1
21 "	9.44	—	2.45	11.9	9.76	.48	10.2	2.72	.19	7.33	.3
22 "	14.58	—	1.65	16.2	14.0	1.16	15.1	3.55	.41	11.2	.3
23 "	—	—	—	—	4.59	.45	5.04	1.26	.09	3.69	[illegible]
Weekly Totals	50.9	5.12	15.4	71.3	59.9	3.56	63.4	15.9	1.33	46.3	[illegible]
Weekly Totals											
Period Totals	69.8	12.3	109.	190.	182.	4.24	186.	51.0	2.88	133.	5.25

Franklin Solid Waste Recovery Plant – Material Balance – Fiber Recovery System Date 4-23 March 78

Day	INPUTS Cyclone [illegible] Screen	White Water	[illegible] Waste	Total Inputs	OUTPUTS Total Outputs	[illegible]	[illegible]	[illegible]	Thickener + Press [illegible]	Recovered Fiber
Day	Dry Weight (tons)	Dry Weight (tons)	Dry Wt (tons)	Dry Weight (tons)	Dry Weight (tons)	Dry Weight (tons)	Dry Weight (tons)	Dry Weight (tons)	Dry Weight (tons)	Dry Weight (tons)
4 Mar	17.3	.03	.1[illegible]	17.5	17.2	5.44	2.15	5.02	.50	4.21
5 "	23.5	—	.20	23.7	24.3	2.20	1.45	7.43	1.33	5.88
6 "	25.2	.14	.21	25.0	[illegible]	5.43	2.04	8.17	1.43	3.32
7 "	25.6	.20	.26	26.3	21.6	[illegible]	1.53	11.1	.59	5.26
8 "	24.4	1.95	.23	26.6	24.1	10.9	1.87	4.5	1.62	6.[illegible]
Weekly Totals	115.	2.33	1.07	120.	122.	29.4	9.2	36.2	5.27	24.4
11 Mar	19.0	—	.21	19.2	20.2	4.40	1.65	4.34	1.13	4.52
12 "	21.4	1.07	.2[illegible]	25.2	24.0	10.5	1.27	9.15	1.24	5.38
13 "	10.6	—	.17	10.7	21.8	4.61	.37	2.19	.91	3.26
14 "	17.6	—	.17	17.8	17.2	8.43	1.55	5.43	.94	4.12
15 "	32.8	2.64	.22	35.6	35.4	20.3	2.63	1.19	1.56	3.35
Weekly Totals	101.9	3.68	.97	[illegible]	115.	[illegible]	7.73	[illegible]	5.83	25.3
18 Mar	10.4	.25	.12	10.8	10.6	2.85	.35	2.02	.50	3.21
19 "	3.01	.17	.12	3.27	3.11	2.14	.57	.34	.2	3.30
20 "	6.70	.50	.26	7.26	7.29	1.44	.50	1.23	.49	2.33
21 "	6.73	.31	.07	7.11	6.26	2.01	.44	1.69	.47	2.05
22 "	4.38	.28	.05	4.71	4.22	1.34	.31	.78	.42	1.81
Weekly Totals	31.2	1.51	.37	33.3	31.5	12.9	2.57	5.36	2.31	12.7
Weekly Totals										
Period Totals	257.	4.38	2.42	263	272.	89.9	18.6	51.5	14.4	67.4

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE DIAGRAM - TOTAL PLANT DATE ____________


RECYCLED TO HYDRAPULPER
____ TONS
GLASS RECOVERY SYSTEM
OPERATION TIME ____ HRS
FLINT ____ TONS
GREEN GLASS ____ TONS
AMBER GLASS ____ TONS
ALUMINUM ____ TONS
MAGNETIC METAL ____ TONS
LANDFILLED 18.8 TONS
CYCLONE REJECT SYS. (GRIT)
18.8 TONS
MAGNETIC JUNK
11.8 TONS
NON-MAGNETIC JUNK
7.7 TONS
UNPROCESSABLE JUNK
3.3 TONS
REFUSE
123.9 TONS (DRY)
148.6 TONS (WET) *
245 GAL
1.33 TONS
HYDRASPOSAL A
(HYDRAPULPER SYSTEM)
OPERATION TIME 24.2 HRS
CYCLONE PROCESS. WT.
108.5 TONS
CITY WATER 181,500 GAL
SLUDGE
1.80 TONS
12.6 TONS
THICKENED
20.2 TONS
HYDRASPOSAL B
(REACTOR SYSTEM)
OPERATION TIME 16.4 HRS
OXIDIZED SLUDGE TO MTD 40,300 GAL
1.84 TONS
FINE REJECTS
20.9 TONS
FIBER RECOVERY REJECTS
33.2 TONS
66.4 TONS
.61
81,000 GAL
3.4 TONS
FIBER RECOVERY SYSTEM
OPERATION TIME 16.1 HRS
RECOVERED FIBER
15.5 TONS TOTAL
13.6 TONS FIBER
3.6 TONS
FINE REJECTS
21.2 TONS
CYCLONE REJECTS OVERFLOW
7.5 TONS
WHITE WATER TO FIBER RECOVERY 81,000 GAL
3.4 TONS
WHITE WATER TO HYDRAPULPER 1,010,000 GAL
34.2 TONS
WHITE WATER TO MTD 252,000 GAL
10.1 TONS
WHITE WATER SYSTEM
PROCESS WATER TO CYCLONE

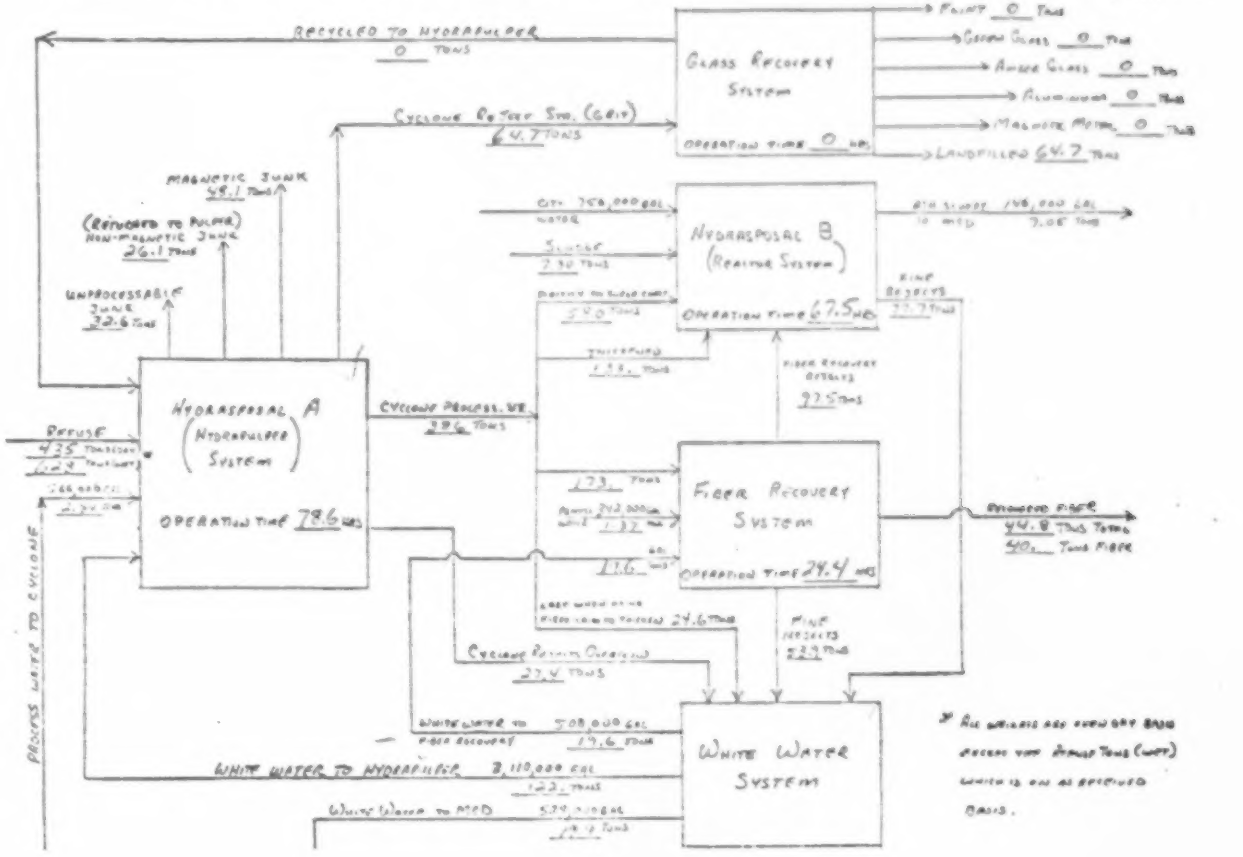
AVERAGE WEEKLY DATA (OPERATING)

* ALL WEIGHTS ARE OVEN DRY BASIS EXCEPT THE REFUSE TONS (WET) WHICH IS ON AN AS-RECEIVED BASIS.

APPENDIX C-4

25 MAR - 20 APR, 1974

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE DIAGRAM - TOTAL PLANT DATE 25 MAR - 20 APR 1974


RECYCLED TO HYDRAPULPER
0 TONS
CYCLONE REJECT STR. (GRIT)
64.7 TONS
GLASS RECOVERY SYSTEM
OPERATION TIME 0 HRS
FLINT 0 TONS
GREEN GLASS 0 TONS
AMBER GLASS 0 TONS
ALUMINUM 0 TONS
MAGNETIC METAL 0 TONS
LANDFILLED 64.7 TONS
MAGNETIC JUNK
48.1 TONS
(RETURNED TO PULPER)
NON-MAGNETIC JUNK
26.1 TONS
UNPROCESSABLE JUNK
32.6 TONS
CITY 750,000 GAL
WATER
SLUDGE
2.30 TONS
[illegible] TO SLUDGE [illegible]
59.0 TONS
THICKENED
1.33 TONS
HYDRASPOSAL B
(REACTOR SYSTEM)
OPERATION TIME 67.5 HRS
[illegible] 146,000 GAL
10 MGD 7.05 TONS
FINE REJECTS
22.7 TONS
FIBER RECOVERY REJECTS
22.5 TONS
HYDRASPOSAL A
(HYDRAPULPER SYSTEM)
OPERATION TIME 78.6 HRS
REFUSE
435 TONS (DRY)
624 TONS (WET)
566,000 GAL
PROCESS WATER TO CYCLONE
CYCLONE PROCESS. WR.
296 TONS
173 TONS
242,000 GAL
1.32 TONS
11.6 TONS
[illegible] FIBER [illegible] 24.6 TONS
FIBER RECOVERY SYSTEM
OPERATION TIME 24.4 HRS
RECOVERED FIBER
44.8 TONS TOTAL
40. TONS FIBER
FINE REJECTS
23.9 TONS
CYCLONE REJECTS OVERFLOW
27.4 TONS
WHITE WATER TO FIBER RECOVERY 508,000 GAL
19.6 TONS
WHITE WATER TO HYDRAPULPER 3,110,000 GAL
122. TONS
WHITE WATER TO MCD 579,000 GAL
WHITE WATER SYSTEM

* ALL WEIGHTS ARE OVEN DRY BASIS EXCEPT FOR REFUSE TONS (WET) WHICH IS ON AS RECEIVED BASIS.

Franklin Solid Waste Reduction Plant - Material Balance - Hydrasposal Subsystem A   Date 25 Mar - 20 Apr. 1974

Date	Wet Weights				Inputs				Outputs				
	Refuse as Received		Pulper Input	Unprocessable Junk	Pulper Input	White Water to Pulper	Process Water to Cyclone		Nonmagnetic Junk	Magnetic Junk	Cyclone Rejects	Cyclone Pulp Stream	Cyclone Reject Overflow
Day Mo.	Moisture Content (%)	Wet Weight (Tons)	Wet Weight (Tons)	Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)		Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)
25 Mar	36.3%	14.6	13.1	1.5	7.8	1.76	.05		.96	.79	2.06	7.62	—
26 Mar	27.0%	36.7	35.9	0.8	26.0	6.49	.17		1.23	2.86	4.93	23.31	1.35
27 Mar	13.3%	15.0	13.4	1.6	11.4	3.92	.13		.96	1.02	1.14	13.55	—
28 Mar	24.7%	38.8	36.2	2.6	26.6	6.95	.18		2.49	3.06	2.43	26.58	—
29 Mar	26.4%	28.0	25.5	2.5	18.1	5.00	.12		1.60	2.47	4.03	17.66	—
Weekly Totals	25.6%	133.	124.	9.0	89.9	24.12	.65		7.24	10.20	14.59	88.72	1.35
1 Apr	—	—	—	—	—	—	—		—	—	—	—	—
2 Apr	28.7%	44.9	41.9	3.0	29.0	6.51	.29		1.23	2.83	2.19	28.27	2.95
3 Apr	26.3%	31.6	30.6	1.0	22.3	3.99	.17		1.28	2.01	4.83	18.14	1.37
4 Apr	34.7%	37.8	37.1	0.7	24.0	7.91	.24		1.29	3.37	3.25	25.54	—
5 Apr	36.0%	37.8	37.6	0.2	24.0	5.92	.15		1.36	2.94	3.39	18.65	4.90
Weekly Totals	31.4%	152.	147.	4.9	99.3	24.33	.85		5.16	11.15	13.66	90.60	9.22
8 Apr	42.8%	25.7	23.8	1.9	12.8	4.15	.08		.76	2.12	1.93	11.98	1.69
9 Apr	41.8%	35.2	34.2	1.0	19.5	4.65	.14		1.21	2.58	3.28	16.69	1.37
10 Apr	7.1%	7.0	4.7	2.3	4.2	1.36	.04		.49	.84	1.16	4.14	.13
11 Apr	39.4%	64.5	63.5	1.0	38.1	13.08	.23		2.49	4.31	5.95	34.33	4.82
12 Apr	—	—	—	—	—	—	—		—	—	—	—	—
Weekly Totals	38.9%	132.	126.	6.2	74.6	23.24	.49		4.95	9.85	12.32	67.14	8.01
15 Apr	12.7%	25.2	18.5	6.7	15.3	5.49	.12		.98	1.85	3.40	16.48	.70
16 Apr	34.6%	68.4	67.4	1.0	43.7	13.56	.22		1.55	4.74	5.60	44.15	2.40
17 Apr	—	13.8	12.2	1.6	14.1	4.27	.08		1.10	1.83	3.36	12.78	.99
18 Apr	38.3%	51.4	49.4	2.0	29.7	13.09	.20		1.81	3.70	5.90	31.32	1.32
19 Apr	29.3%	52.2	51.0	1.2	35.7	14.24	.23		3.33	4.76	5.89	34.65	3.37
Weekly Totals	28.4%	211.	198.	12.5	138.	50.65	.85		8.77	16.88	24.15	139.	8.78
Period Totals	30.7%	628.	595	32.6	402.	122.	2.84		26.1	48.1	64.7	386.	27.4

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE - HYDRASPOSAL SUBSYSTEM B (DEWATERING + REACTOR SECTIONS) DATE 25 MAR - 20 APR 1974

DATE	INPUTS TO SURGE CHEST FROM OTHER SYSTEMS				DEWATERING SECTION						REACTOR SECTION
	CYCLONE REJECTS SYS		FIBER RECOVERY REJECTS	TOTAL	INPUTS		TOTAL MATERIAL IN SECTION	OUTPUTS			OUTPUT
	DIRECT TO SURGE CHEST	THICKENER			SURGE CHEST OUTPUT	SLUDGE CHEST OUTPUT		THICKENER FILTRATE STREAM	CONE PRESS FILTRATE STREAM	CONE PRESS PRESSED STREAM	ASH SLURRY FROM REACTOR
DAY MO	DRY WT. (TONS)	DRY WT. (TONS)	DRY WT. (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WT. (TONS)
25 MAR	3.05	—	2.55	5.60	4.55	—	4.55	.76	.04	3.75	.14
26 MAR	8.61	—	3.73	12.34	7.54	.47	8.01	2.58	.19	5.24	.19
27 MAR	7.74	—	4.74	12.48	5.96	.27	6.23	1.65	.12	4.46	.17
28 MAR	13.12	—	14.50	27.62	25.78	.11	25.89	7.04	.52	18.33	.69
29 MAR	3.75	.30	5.32	9.37	8.80	.01	8.81	2.69	.19	5.93	.28
30 MAR	—	—	—	—	6.87	.01	6.88	1.86	.14	4.88	.11
WEEKLY TOTALS	36.27	.30	30.84	67.41	59.50	.87	60.37	16.58	1.20	42.59	1.58
1 APR	—	—	—	—	—	—	—	—	—	—	—
2 APR	.60	23.35	—	23.95	14.36	.07	14.43	3.43	.22	10.70	.42
3 APR	4.12	—	8.34	12.46	12.68	.16	12.84	2.69	.26	9.89	.37
4 APR	—	11.33	5.70	17.03	18.11	.46	18.57	4.40	.45	13.72	.51
5 APR	.15	15.62	—	15.77	14.27	.43	14.70	4.15	.37	10.18	.39
6 APR	—	—	—	—	6.71	.05	6.76	1.64	.16	4.96	.19
WEEKLY TOTALS	4.87	50.30	14.04	69.21	66.13	1.17	67.30	16.31	1.56	49.45	1.84
8 APR	.07	—	7.34	7.41	5.70	.06	5.76	1.23	.11	4.42	.16
9 APR	1.93	—	10.03	10.10	10.25	.29	10.54	2.76	.23	7.55	.28
10 APR	.10	—	2.69	2.79	—	—	—	—	—	—	—
11 APR	.16	28.85	—	29.01	22.47	.41	22.88	7.55	.66	14.67	.54
12 APR	—	—	—	—	—	—	—	—	—	—	—
13 APR	—	—	—	—	5.21	.19	5.40	1.59	.14	3.67	.14
WEEKLY TOTALS	2.26	28.85	20.06	49.31	43.63	0.95	44.58	13.13	1.14	30.31	1.12
15 APR	.43	12.02	2.46	14.91	8.76	.30	9.06	2.36	.16	6.54	.24
16 APR	—	25.69	5.99	31.68	23.24	1.29	24.53	6.96	.53	17.04	.63
17 APR	.08	4.84	1.61	6.53	7.79	.45	8.24	2.73	.22	5.29	.20
18 APR	2.44	10.65	12.93	26.02	24.01	.97	24.98	4.98	.39	19.61	.73
19 APR	11.66	.08	9.57	21.31	20.95	.91	21.86	7.00	.49	14.37	.53
20 APR	—	—	—	—	6.53	.39	6.92	1.88	.14	4.90	.18
WEEKLY TOTALS	14.61	53.28	32.56	100.45	91.28	4.31	95.59	25.91	1.93	67.75	2.51
PERIOD TOTALS	58.0	133.	97.5	286.	261.	7.30	268.	71.9	5.83	190.	7.05

WHITE WATER TO MCD WASTE WATER TREATMENT PLANT

DATE 25 MAR-20 APR. 1974.

V_{592} = VOLUME OF WHITE WATER TO MCD

= + TOTAL PROCESS WATER TO SOLID WASTE PLANT 820,000 V_{600}

+ TOTAL MOISTURE IN REFUSE 46,300 V'_{103}

$\begin{pmatrix} \text{Total Wet Wt} - \text{Total Dry Wt} \\ 628 \text{ Tons} - 435 \text{ Tons} \end{pmatrix} 240$

- TOTAL WATER SENT TO LOGAN LINE WITH FIBER 283,000 V_{316}

- TOTAL WATER INPUT TO REACTOR WITH REFUSE 55,500 V'_{204}

$\begin{pmatrix} \text{Total Wt Press Proc. Str.} \\ 190 \text{ Tons} \end{pmatrix} 292$

528,000 V_{592}

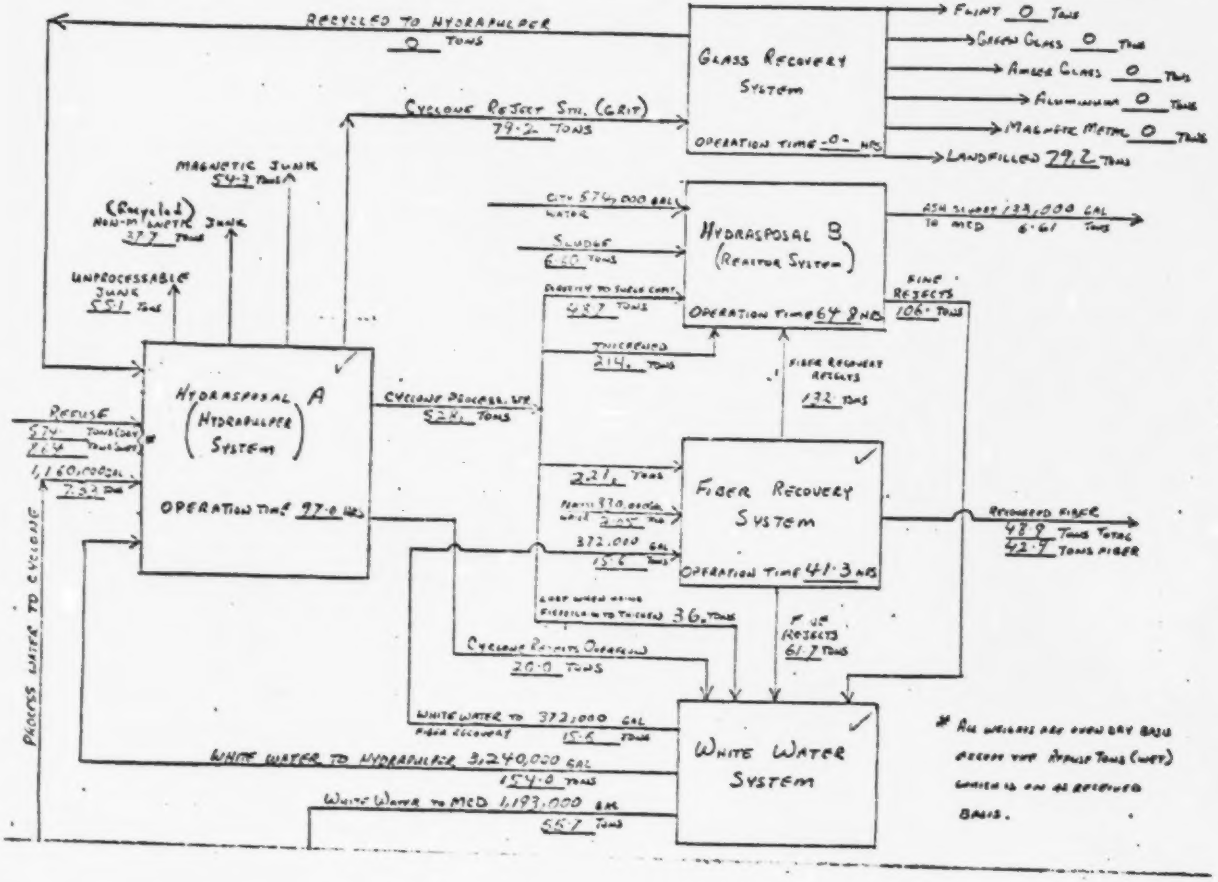
W_{592} = DRY SOLIDS CONTENT OF WHITE WATER SENT TO MCD

$\begin{pmatrix} \text{gallons white water} \\ 528{,}000 \end{pmatrix} \begin{pmatrix} \text{solids content \%} \\ \text{Ave.} = .9032 \end{pmatrix} \left(4.17 \times 10^{-5}\right) =$ 19.9 W_{592}

APPENDIX C-5

22 APR - 18 MAY, 1974

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE DIAGRAM - TOTAL PLANT DATE 22 APR - 18 MAY, 74


RECYCLED TO HYDRAPULPER
0 TONS
GLASS RECOVERY SYSTEM
OPERATION TIME -0- HRS
FLINT 0 TONS
GREEN GLASS 0 TONS
AMBER GLASS 0 TONS
ALUMINUM 0 TONS
MAGNETIC METAL 0 TONS
LANDFILLED 79.2 TONS
CYCLONE REJECT STM. (GRIT)
79.2 TONS
MAGNETIC JUNK
54.3 TONS
(Recycled) NON-MAGNETIC JUNK
37.7 TONS
UNPROCESSABLE JUNK
55.1 TONS
REFUSE
574 TONS (DRY)
714 TONS (WET)
1,160,000 GAL
7.52 TONS
HYDRASPOSAL A
(HYDRAPULPER SYSTEM)
OPERATION TIME 97.0 HRS
CYCLONE PROCESS. STR.
528. TONS
CITY 574,000 GAL
WATER
SLUDGE
6.60 TONS
GRAVITY TO SURGE CHEST
48.7 TONS
THICKENED
214. TONS
HYDRASPOSAL B
(REACTOR SYSTEM)
OPERATION TIME 64.8 HRS
ASH SLURRY 133,000 GAL
TO MCD 6.61 TONS
FINE REJECTS
106. TONS
FIBER RECOVERY REJECTS
132 TONS
221. TONS
330,000 GAL
2.05 TONS
372,000 GAL
15.6 TONS
FIBER RECOVERY SYSTEM
OPERATION TIME 41.3 HRS
RECOVERED FIBER
48.9 TONS TOTAL
42.9 TONS FIBER
LOST WHEN USING FIBERFILM TO THICKEN 36. TONS
CYCLONE REJECTS OVERFLOW
20.0 TONS
FINE REJECTS
61.7 TONS
WHITE WATER TO FIBER RECOVERY 372,000 GAL
15.6 TONS
WHITE WATER TO HYDRAPULPER 3,240,000 GAL
154.0 TONS
WHITE WATER TO MCD 1,193,000 GAL
55.7 TONS
WHITE WATER SYSTEM
PROCESS WATER TO CYCLONE

* ALL WEIGHTS ARE OVEN DRY BASIS EXCEPT THE REFUSE TONS (WET) WHICH IS ON AS RECEIVED BASIS.

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE - HYDRASPOSAL SUBSYSTEM A DATE 22 APR - 18 MAY 74

DATE	WET WEIGHTS				INPUTS				OUTPUTS				
	REFUSE AS RECEIVED		PULPER INPUT	UNPROCESSABLE JUNK	PULPER INPUT	WHITE WATER TO PULPER	REJECTS WASH TO CYCLONE		NONMETALLIC JUNK	MAGNETIC JUNK	CYCLONE REJECTS	CYCLONE ACCEPTS STREAM	CYCLONE REJECT OVERFLOW
DAY MO.	MOISTURE CONTENT (%)	WET WEIGHT (TONS)	WET WEIGHT (TONS)	WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)		DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)
22 Apr	28.0%	31.4	26.9	4.5	18.1	5.80	.49		1.62	2.00	3.66	20.23	.23
23 "	30.9%	47.8	47.8	2.0	32.4	9.34	.80		2.66	3.06	4.74	33.76	—
24 "	30.7%	35.6	33.9	1.7	22.9	7.70	.57		2.13	3.23	3.50	23.00	1.86
25 "	33.8%	36.1	33.6	2.5	21.4	6.43	.24		1.90	2.20	2.70	22.00	1.36
26 "	38.3%	15.4	13.0	2.4	7.1	4.14	.15		1.00	1.37	1.09	9.25	.60
WEEKLY TOTALS	32.0%	166.3	155.2	13.1	101.9	33.41	2.25		9.31	11.86	15.69	108.24	4.05
29 Apr	20%	45.3	36.2	9.1	35.3	5.65	.38		1.78	2.19	5.12	31.25	1.23
30 "	38.8%	41.7	40.2	1.5	24.0	6.02	.37		1.45	2.82	3.84	23.20	1.02
1 May	33.7%	45.4	44.9	.5	27.6	6.43	.38		2.20	2.99	3.79	28.70	.28
2 "	41.1%	53.7	51.7	2.0	27.6	16.47	.52		2.70	3.69	6.34	34.87	1.15
3 "	34.2%	47.9	47.4	.5	31.0	8.79	.31		1.39	3.14	4.59	32.70	1.02
WEEKLY TOTALS	30.7%	234.0	220.4	13.6	149.5	43.36	2.02		9.72	15.43	23.68	150.72	4.7
6 May	27.8%	40.7	34.0	6.7	22.7	5.64	.21		1.64	1.79	3.87	22.66	—
7 "	34.4%	41.0	37.7	3.3	23.6	11.06	.30		2.07	2.58	4.63	26.74	.53
8 "	51.7%	55.3	54.1	1.2	25.4	11.51	.38		2.21	3.34	4.89	27.71	1.23
9 "	33.1%	57.1	55.3	1.80	36.4	9.58	.35		1.70	3.12	4.67	37.48	1.56
10 "	31.3%	49.9	47.1	2.8	31.5	7.80	.29		1.87	3.36	4.84	29.95	1.25
WEEKLY TOTALS	37.4%	244	228	15.8	139.6	45.59	1.53		9.49	14.19	22.90	144.54	4.57
13 May	35.2%	41.3	37.7	3.4	24.2	3.41	.27		1.54	2.22	1.11	23.04	—
14 "	39.5%	45.3	43.5	1.8	25.6	7.36	.34		2.00	3.20	3.82	23.78	1.83
15 "	18.7%	30.5	29.0	1.5	23.3	3.90	.22		1.40	2.00	4.95	20.54	.49
16 "	34.3%	57.5	54.8	2.7	35.1	9.59	.41		2.40	3.50	3.50	34.62	2.46
17 "	45.3%	42.6	39.4	3.2	20.1	6.86	.29		1.80	1.95	3.60	20.31	1.95
WEEKLY TOTALS	35.1%	217.2	204.6	12.6	128.3	31.2	1.53		9.14	12.87	16.78	124.49	6.73
PERIOD TOTALS	34%	863.5	808.2	55.1	519.3	153.6	7.33		37.7	54.3	79.2	528.0	20.0

Franklin Solid Waste Reduction Plant - Material Balance - Hydrasposal Subsystem B (Dewatering + Reactor Sections) Date 22 APR - 18 MAY

DATE	Inputs to Surge Chest from Other Systems				Dewatering Section						Section Output
	Cyclone	Process Str.	Fiber Recovery Rejects	TOTAL	Inputs		Total	Outputs			Ash Slurry from Reactor
	[illegible] Surge Chest	Thickened			Surge Chest Output	Sludge Chest Output	Material in Section	Thickener Reject Stream	Cone Press Reject Stream	Cone Press Process Stream	
Day Mo	Dry Wt. (Tons)	Dry Wt. (Tons)	Dry Wt. (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Wt. (Tons)
22 Apr	.25	12.6	2.24	15.09	7.97	.360	8.33	2.67	.150	5.54	.22
23 "	2.40	11.4	6.40	20.2	18.8	.740	19.5	5.74	.330	13.5	.45
24 "	9.11	—	10.2	19.3	20.2	.742	20.9	6.59	.373	13.9	.27
25 "	.11	8.07	4.96	13.1	12.0	.314	12.31	4.60	.180	7.53	.16
26 "	.29	3.83	2.18	6.30	11.46	.612	12.0	4.81	.222	7.04	.22
Weekly Totals	12.16	35.9	26.0	74.0	70.43	2.77	73.0	24.41	1.25	47.5	1.32
29 Apr	.21	12.87	3.38	16.5	9.56	.300	9.86	2.35	.180	7.30	.15
30 "	8.03	—	8.59	16.6	15.3	.510	15.8	4.17	.320	11.3	.33
1 May	18.5	—	5.52	24.0	18.7	.520	19.2	6.11	.461	12.6	.27
2 "	.08	29.4	—	29.5	29.6	.820	30.4	10.1	.690	19.6	.33
3 "	.11	27.5	—	27.6	20.0	.390	20.4	5.79	.440	14.2	.24
Weekly Totals	26.9	69.8	17.5	114.0	93.2	2.54	95.7	29.5	2.09	65	1.32
6 May	.44	18.8	—	19.2	7.05	.020	7.07	1.46	.110	5.5	.13
7 "	3.54	19.6	—	23.1	32.6	.110	32.7	7.41	.630	24.7	.39
8 "	—	18.6	11.4	30.0	31.4	.090	31.5	7.47	.750	23.3	.60
9 "	.32	2.4	10.7	23.4	23.5	.100	23.6	5.69	.430	18.2	.52
10 "	.10	10.5	6.95	17.5	17.2	.005	17.2	4.68	.270	12.3	.38
Weekly Totals	4.4	79.8	29.0	113.	111.7	.325	112.0	26.7	2.19	84.0	2.02
13 May	—	10.56	12.6	23.16	18.9	.040	18.9	4.49	.320	14.1	.45
14 "	—	3.98	10.5	14.5	14.0	.060	14.0	4.02	.310	9.70	.56
15 "	3.80	—	9.76	13.6	11.1	.040	11.1	2.67	.190	8.30	.31
16 "	.55	11.3	12.6	24.5	19.0	.550	19.5	3.66	.330	15.6	.26
17 "	.89	2.25	14.0	17.1	22.0	.260	22.3	4.28	.330	17.6	.37
Weekly Totals	5.24	28.04	59.5	92.9	85	.950	85.9	19.1	1.48	65.3	1.95
											[illegible]
Period Totals	48.7	214.	132.0	394.	360.3	6.60	366.6	98.7	7.01	261.8	6.61

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE - FIBER RECOVERY SYSTEM   DATE 22 APR - 18 M

DATE	INPUTS				OUTPUTS						
	CYCLONE PROCESS STREAM	WHITE WATER	PROCESS WATER	TOTAL INPUTS	TOTAL OUTPUTS	SELECTIFIER REJECT STREAM	CENTRIFUGAL CLEANERS REJECT STREAM	RUN-DOWN SCREEN REJECT STREAM	THICKENER + PRESS REJECT STR.	RECOVERED FIBER TOTAL SOLIDS	RECOVERED FIBER (O.D.) FIBER ONLY
DAY MO.	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)
22 APR	4.83	.29	.08	5.20	5.02	1.71	.53	1.69	.12	.97	.85
23 "	16.4	1.02	.25	17.7	16.2	4.73	1.67	5.75	.56	3.45	3.03
24 "	14.5	1.46	.22	16.2	17.4	8.74	1.49	3.16	.56	3.41	3.00
25 "	11.5	.70	.09	12.3	11.5	3.82	1.14	1.80	.20	4.53	3.99
26 "	4.87	.14	.05	5.06	5.51	1.54	.64	1.54	.19	1.60	1.41
WEEKLY TOTALS	52.1	3.61	.69	56.5	55.6	20.5	5.5	13.9	1.63	14.0	12.3
29 APR	12.4	.10	.16	12.7	9.34	2.01	1.37	2.48	.42	3.06	2.69
30 "	9.87	1.59	.13	11.6	14.5	6.41	1.68	2.57	.55	2.80	2.47
1 MAY	9.35	.35	.1	9.8	8.9	3.54	1.98	1.30	.08	2.00	1.76
2 "	—	—	—	—	—	—	—	—	—	—	—
3 "	—	—	—	—	—	—	—	—	—	—	—
WEEKLY TOTALS	31.6	2.04	.39	34.1	32.7	12.5	5.03	6.35	1.05	7.9	6.92
6 MAY	—	—	—	—	—	—	—	—	—	—	—
7 "	—	—	—	—	—	—	—	—	—	—	—
8 "	10.0	1.09	.05	11.4	15.4	10.4	1.00	1.64	.33	2.06	1.81
9 "	21.3	1.38	.14	22.8	21.6	8.5	2.2	6.60	.39	3.92	3.45
10 "	15.8	1.42	.12	17.3	15.9	5.5	1.5	4.39	.55	3.99	3.51
WEEKLY TOTALS	47.1	3.89	.31	51.5	52.9	24.4	4.7	12.6	1.27	9.97	8.77
13 MAY	15.3	.94	.08	16.3	19.0	11.5	1.08	3.59	.34	2.48	2.18
14 "	19.4	.95	.17	20.5	20.7	8.80	1.72	5.56	.47	4.19	3.69
15 "	15.7	.99	.11	16.8	15.7	8.52	1.24	2.33	.38	3.25	2.86
16 "	21.0	1.03	.15	22.2	22.4	9.80	2.82	5.10	.50	4.14	3.64
17 "	19.0	2.18	.15	21.3	23.7	11.9	2.16	6.35	.37	2.92	2.57
WEEKLY TOTALS	90.4	6.09	.66	97.1	101.5	50.5	9.02	22.7	2.06	17.00	14.9
PERIOD TOTALS	221.2	15.6	2.05	239.2	242.7	107.9	24.2	55.7	6.01	48.9	42.9

WHITE WATER TO MCD WASTE WATER TREATMENT PLANT

DATE 22APR - 18MAY.74

V_{592} = VOLUME OF WHITE WATER TO MCD

= + TOTAL PROCESS WATER TO SOLID WASTE PLANT 1,550,000 V_{608} gallons

+ TOTAL MOISTURE IN REFUSE 69,300 V'_{108}

$\left(\begin{matrix}\text{TOTAL WET WT} - \text{TOTAL DRY WT}\\ 808.2 - 519.3\end{matrix}\right)240$

− TOTAL WATER SENT TO LOBAN LINE WITH FIBER 349,400 V_{316}

− TOTAL WATER INPUT TO REACTOR WITH REFUSE 76,480 V'_{204}

$\left(\begin{matrix}\text{TOTAL WT PRESS REAC. STR.}\\ 261.8\end{matrix}\right)292$

1,173,500 V_{592} Gallons

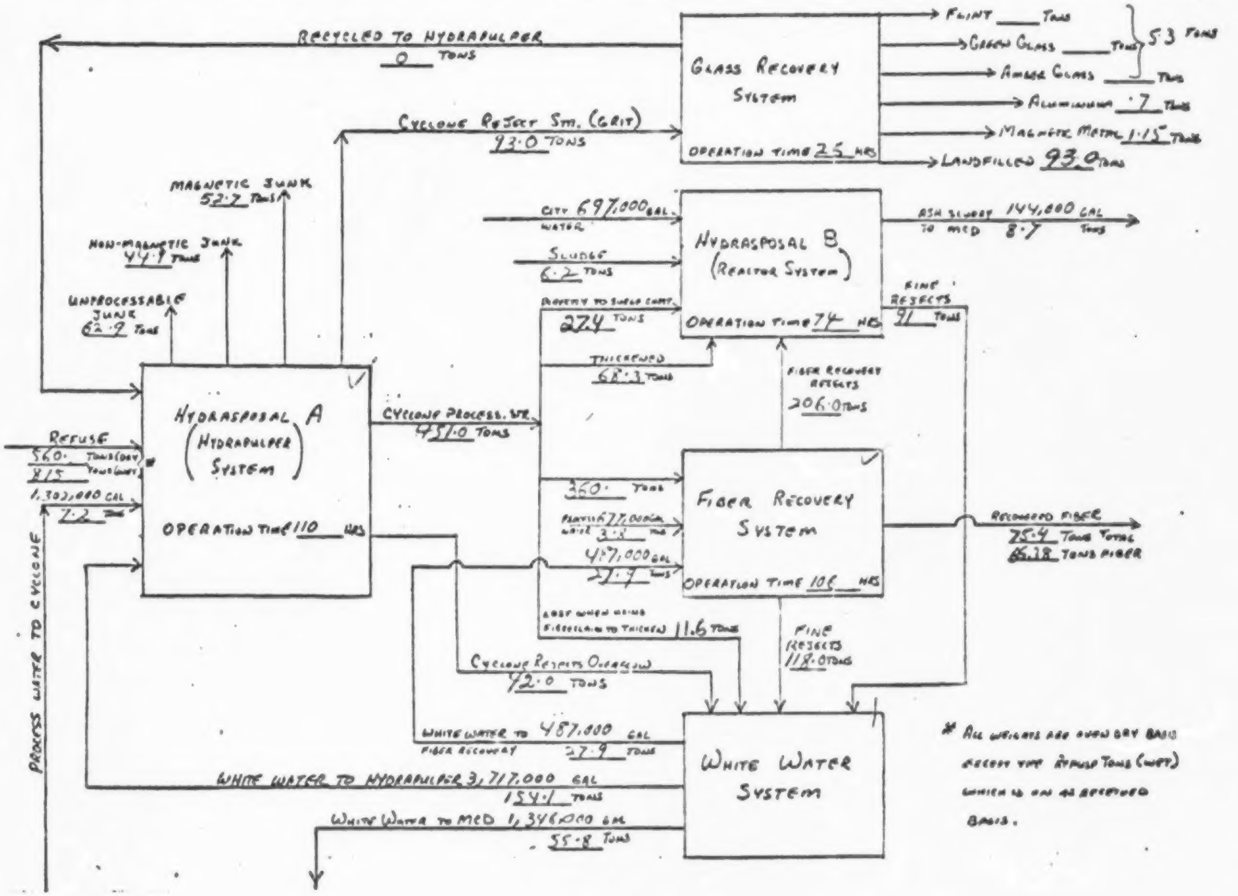
W_{592} = DRY SOLIDS CONTENT OF WHITE WATER SENT TO MCD

$\left(\begin{matrix}\text{gallons white water}\\ 1,173,500\end{matrix}\right)\left(\begin{matrix}\text{solids content \%}\\ 1.12\end{matrix}\right)\left(4.17\times10^{-5}\right) =$ 55.7 Tons W_{592}

APPENDIX C-6

20 MAY - 15 JUN, 1974

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE DIAGRAM - TOTAL PLANT DATE MAY - 15 JUNE, 74


RECYCLED TO HYDRAPULPER
0 TONS
GLASS RECOVERY SYSTEM
OPERATION TIME 25 HRS
FLINT ___ TONS
GREEN GLASS ___ TONS
AMBER GLASS ___ TONS
5.3 TONS
ALUMINUM .7 TONS
MAGNETIC METAL 1.15 TONS
LANDFILLED 93.0 TONS
CYCLONE REJECT STM. (GRIT)
93.0 TONS
MAGNETIC JUNK
52.7 TONS
NON-MAGNETIC JUNK
44.9 TONS
UNPROCESSABLE JUNK
62.9 TONS
CITY WATER 697,000 GAL.
SLUDGE
6.2 TONS
RECOVERY TO SURGE CHEST
274 TONS
HYDRASPOSAL B
(REACTOR SYSTEM)
OPERATION TIME 74 HRS
ASH SLURRY TO MED 144,000 GAL
8.7 TONS
FINE REJECTS
91 TONS
THICKENED
68.3 TONS
FIBER RECOVERY REJECTS
206.0 TONS
REFUSE
560. TONS (DRY) *
815 TONS (WET)
1,302,000 GAL
7.2 TONS
HYDRASPOSAL A
(HYDRAPULPER SYSTEM)
OPERATION TIME 110 HRS
CYCLONE PROCESS. STR.
451.0 TONS
360. TONS
PLANT WATER 677,000 GAL
3.8 TONS
417,000 GAL
27.7 TONS
FIBER RECOVERY SYSTEM
OPERATION TIME 106 HRS
RECOVERED FIBER
75.4 TONS TOTAL
65.38 TONS FIBER
LOST WHEN USING FIBERCLAIM TO THICKEN 11.6 TONS
FINE REJECTS
118.0 TONS
CYCLONE REJECTS OVERFLOW
42.0 TONS
WHITE WATER TO FIBER RECOVERY 487,000 GAL
27.9 TONS
WHITE WATER TO HYDRAPULPER 3,717,000 GAL
154.1 TONS
WHITE WATER TO MED 1,346,000 GAL
55.8 TONS
WHITE WATER SYSTEM
PROCESS WATER TO CYCLONE

* ALL WEIGHTS ARE OVEN DRY BASIS EXCEPT THE REFUSE TONS (WET) WHICH IS ON AS RECEIVED BASIS.

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE - HYDRASPOSAL SUBSYSTEM A   DATE 5/20 - 6/14/74

DATE	WET WEIGHTS				INPUTS				OUTPUTS				
	REFUSE AS RECEIVED		PULPER INPUT	UNPROCESSABLE JUNK	PULPER INPUT	WHITE WATER TO PULPER	PROCESS WATER TO CYCLONE		NONMAGNETIC JUNK	MAGNETIC JUNK	CYCLONE REJECTS	CYCLONE PROCESS STREAM	CYCLONE REJECT OVERFLOW
DAY MO.	MOISTURE CONTENT (%)	WET WEIGHT (TONS)	WET WEIGHT (TONS)	WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)		DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)
20-5	26.6	61.6	57.5	4.1	41.1	10.6	.54		3.52	4.74	7.32	34.8	3.65
21-5	47.2	36.0	34.0	2.0	17.0	5.4	.31		2.60	2.40	3.00	16.9	2.30
22-5	39.2	47.5	44.7	2.8	26.1	7.9	.37		3.0	2.90	4.30	20.1	6.74
23-5	40.5	39.3	34.4	4.9	18.5	8.2	.38		2.0	2.40	2.63	21.1	1.97
24-5	38.0	45.2	43.2	2.0	26.0	12.27	.45		1.9	3.0	2.83	30.5	2.45
WEEKLY TOTALS	37.0 %	229.6	213.8	15.8	128.7	44.37	2.05		13.02	15.41	19.98	123.4	17.11
27-5	—	—	—	—	HOLIDAY		—		—	—	—	—	—
28-5	42.7	39.3	34.8	4.5	18.0	11.1	.37		2.1	1.8	5.4	18.35	3.77
29-5	27.3	44.7	42.5	2.2	30.3	8.03	.39		2.6	3.1	6.26	27.05	1.83
30-5	25.7	45.6	44.4	1.2	28.1	11.52	.57		2.4	3.4	4.7	30.18	2.13
31-5	22.3	41.2	38.2	3.0	27.0	7.9	.38		2.4	2.85	7.9	24.58	1.88
WEEKLY TOTALS	32.3 %	170.8	159.9	10.9	105.4	38.55	1.71		9.5	11.15	24.26	100.36	9.61
3-6	24.7	39.6	34.6	5.0	21.8	7.27	.34		3.27	2.99	5.5	20.45	2.56
4-6	22.4	42.5	36.2	6.3	26.7	7.57	.37		2.8	2.69	6.81	20.36	2.02
5-6	22.2	37.3	33.7	3.6	25.4	7.61	.33		3.0	2.0	5.65	20.2	2.52
6-6	28.5	44.2	42.9	1.3	30.3	9.47	.43		3.9	2.7	4.2	26.8	2.59
7-6	17.1	43.8	42.3	1.5	34.8	9.54	.51		4.9	3.2	4.0	32.75	—
WEEKLY TOTALS	24.3 %	207.4	189.7	17.7	142.0	41.46	1.98		17.87	13.58	26.16	120.56	9.69
10-6	33.6	42.2	39.6	3.6	25.1	5.47	.31		.8	1.9	4.0	23.6	.55
11-6	31.5	42.0	45.7	2.3	30.6	7.59	.37		1.2	3.9	5.9	26.1	1.50
12-6	39.0	40.2	34.4	5.8	18.7	5.41	.26		.8	1.9	4.2	16.2	1.27
13-6	34.0	40.9	38.5	2.4	24.6	6.96	.31		.9	2.9	4.1	22.6	1.45
14-6	24.2	35.1	30.7	4.4	22.2	4.26	.23		.8	1.9	4.4	18.6	1.03
WEEKLY TOTALS	35.72	207.4	188.9	18.5	121.2	29.69	1.48		4.5	12.5	22.6	107.1	5.8
PERIOD TOTALS	32.42	815.2	752.3	62.9	497.3	154.1	7.2		44.9	52.7	93.0	451.3	42.2

FRANKLIN SOLID WASTE REDUCTION PLANT - MATERIAL BALANCE - HYDRASPOSAL SUBSYSTEM B DATE - 20 MAY - 15 JUNE, 7
(DEWATERING + REACTOR SECTIONS)

DATE	INPUTS TO SURGE CHEST FROM OTHER SYSTEMS				DEWATERING SECTION						REACTOR SECTION OUTPUT
	CYCLONE PROCESS ST.		FIBER RECOVERY REJECTS	TOTAL	INPUTS		TOTAL MATERIAL IN SECTION	OUTPUTS			ASH SLURRY FROM REACTOR
	DIRECT TO SURGE CHEST	TO SAND			SURGE CHEST OUTPUT	SLUDGE CHEST OUTPUT		THICKENER REJECT STREAM	CONE PRESS REJECT STREAM	CONE PRESS PROCESS STREAM	
DAY MO	DRY WT. (TONS)	DRY WT. (TONS)	DRY WT. (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WEIGHT (TONS)	DRY WT. (TONS)
20-5	1.34	16.91	6.9	25.15	24.80	.399	25.20	7.32	.403	17.48	0.69
21-5	.80	3.04	8.6	12.44	13.30	.257	13.56	3.90	.278	9.42	.33
22-5	.37	—	10.8	11.17	8.99	.375	9.36	3.36	.273	5.74	.20
23-5	—	5.50	8.6	14.10	15.30	.610	15.91	5.45	.304	10.25	.56
24-5	.54	7.25	8.8	16.59	15.60	.136	15.74	4.97	.267	10.5	0.32
WEEKLY TOTALS	3.05	32.7	43.7	79.45	77.99	1.78	79.77	25.00	1.52	53.34	2.14
27-5	—	—	—	—	—	—	—	—	—	—	—
28-5	—	7.72	8.3	16.02	11.50	—	11.50	4.64	.110	6.8	0.33
29-5	3.58	7.65	3.1	14.33	13.82	.100	13.92	5.14	.300	8.5	0.34
30-5	1.23	3.58	14.7	19.51	18.60	.170	18.77	6.35	.340	12.1	0.55
31-5	.070	3.63	14.6	18.30	14.49	.290	14.78	5.32	.250	9.2	0.62
WEEKLY TOTALS	4.88	22.58	40.7	68.16	58.41	0.56	58.97	21.45	1.00	36.60	1.64
3-6	.13	4.87	13.51	18.51	13.00	.248	13.25	3.10	.194	10.0	0.38
4-6	.82	3.52	9.56	13.90	12.80	.237	13.04	4.16	.244	8.6	0.41
5-6	.13	3.04	7.44	10.61	11.10	.005	11.10	3.51	.154	7.4	0.52
6-6	.26	1.57	14.22	16.05	16.90	.020	16.92	5.47	.228	11.2	0.70
7-6	1.30	-	13.82	15.12	16.90	.014	16.91	6.43	.245	10.2	0.65
WEEKLY TOTALS	2.64	13.0	58.55	74.19	70.70	0.52	71.22	22.67	1.06	47.40	2.66
10-6	1.26	—	13.33	14.59	15.10	.013	15.11	4.43	.231	10.4	0.42
11-6	—	—	15.60	15.60	14.20	.440	14.64	3.31	.327	11.0	0.44
12-6	11.70	—	12.15	23.85	11.70	.551	12.25	2.42	.252	7.5	0.48
13-6	3.02	—	14.96	17.98	16.90	1.100	18.00	4.03	.417	13.5	0.53
14-6	.501	—	7.05	7.85	9.61	1.27	10.88	2.29	.364	8.3	0.63
WEEKLY TOTALS	16.78	—	63.09	79.87	67.51	3.37	70.88	16.48	1.59	52.70	2.30
PERIOD TOTALS	27.4	68.3	206.0	301.7	274.6	6.2	280.8	85.6	5.2	190.2	8.7

Franklin Solid Waste Reduction Plant - Material Balance - Fiber Recovery System ...... Date 20th May-15J

Date	Inputs				Outputs						
	Cyclone Process Stream	White Water	Process Water	Total Inputs	Total Outputs	Selectifier Reject Stream	Centrifugal Cleaners Reject Stream	Run-Down Screen Reject Stream	Thickener + Pumps Filtrate Str.	Recovered Fiber Total Solids	Recovered Fiber 281 Fiber Only
Day Mo.	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)	Dry Weight (Tons)
20-5	15.19	.61	.13	15.93	12.62	5.70	1.18	2.70	0.43	2.61	2.29
21-5	14.32	.98	.14	15.44	17.45	6.60	1.97	4.50	0.63	3.75	3.30
22-5	20.87	1.43	.19	22.49	23.70	8.20	2.58	8.20	0.61	4.11	3.62
23-5	13.63	4.57	.20	18.46	16.79	7.30	1.35	3.80	0.83	3.51	3.09
24-5	13.42	1.50	.20	15.12	21.73	6.60	2.25	6.80	0.63	5.45	4.80
Weekly Totals	77.43	9.09	.66	87.38	92.29	34.40	9.33	26.00	3.13	19.43	17.10
27-5	—	—	—	—	—	—		—	—	—	—
28-5	10.76	1.74	.12	12.62	14.12	7.30	0.99	3.80	0.31	1.72	1.51
29-5	12.60	.30	.13	13.03	11.27	1.50	1.64	6.50	0.13	1.50	1.32
30-5	28.76	2.94	.33	32.03	36.19	18.60	2.94	9.70	0.60	4.35	3.83
31-5	21.04	3.76	.21	25.01	25.68	12.40	2.19	6.40	0.57	4.12	3.62
Weekly Totals	73.16	8.74	.79	82.69	87.26	39.80	7.76	26.40	1.61	11.69	10.29
3-6	17.56	1.04	.17	18.77	21.86	12.49	1.02	4.80	0.46	3.09	2.72
4-6	15.59	.51	.20	16.30	16.53	8.36	1.20	2.60	0.61	3.76	3.31
5-6	15.04	.16	.19	15.39	14.20	6.64	0.80	1.61	0.85	4.30	3.79
6-6	25.43	.87	.28	26.58	27.29	12.46	1.76	8.50	0.68	3.89	3.43
7-6	28.25	1.45	.35	30.05	26.93	11.36	2.46	8.60	0.55	3.96	3.49
Weekly Totals	101.87	4.03	1.19	107.09	106.81	51.31	7.24	26.11	3.15	19.00	16.74
11-6	22.31	1.19	.20	23.70	23.71	11.10	2.23	5.99	0.54	3.85	3.38
11-6	27.01	1.39	.23	28.63	29.41	12.70	2.90	6.11	1.06	6.64	5.84
12-6	17.69	.61	.17	18.47	21.26	10.60	1.55	3.74	0.74	4.63	4.07
13-6	23.55	2.25	.16	25.96	25.94	12.59	2.37	3.71	2.08	5.19	4.57
14-6	17.04	.56	.16	17.76	19.92	5.01	2.04	6.94	0.95	4.98	4.39
Weekly Totals	107.60	6.00	.92	114.52	120.24	52.00	11.09	26.49	5.37	25.29	22.25
Period Totals	360.1	27.9	3.8	391.7	406.6	177.5	35.4	105.0	13.3	75.4	66.38

WHITE WATER TO MCD WASTE WATER TREATMENT PLANT

DATE 20 MAY - 15 JUNE, 74

V_{592} = VOLUME OF WHITE WATER TO MCD

= + TOTAL PROCESS WATER TO SOLID WASTE PLANT 1,930,000 V_{650}

+ TOTAL MOISTURE IN REFUSE 61,200 V'_{103}

(TOTAL WET WT - TOTAL DRY WT) 240

(752.3 - 497.3) 240

- TOTAL WATER SENT TO LOGAN LOIS WITH FIBER 589,900 V_{316}

- TOTAL WATER INPUT TO REACTOR WITH REFUSE 55,500 V'_{204}

(TOTAL WT PRESS PROC. STR.) 292

(190.24) 292

1,346,000 V_{592}

W_{592} = DRY SOLIDS CONTENT OF WHITE WATER SENT TO MCD

(gallons white water 1,346,000)(solids content % .995)(4.17×10^{-5}) = 55.8 W_{592}

APPENDIX D

FORMS - DATA

1. Special Tests - Lab Sheet
2. Lab Sheet
3. Daily Data Sheet
4. Daily Calculation Sheet

FRANKLIN SOLID WASTE REDUCTION PLANT EVALUATION DATE 9-12 JULY. 79

"SPECIAL TEST LAB SHEET"

TEST	GRIT ANALYSIS (200 MESH SCREEN)				
STREAM I.D.	CYCLONE P.S.	CYCLONE K.S. [illegible]	SEL P.S.	CLNFS P.S.	CLNFS K.S.
SYMBOL/CRUCIBLE #	S_{100}/#6	S_{103}/#11	S_{101}/#19	S_{106}/#8	S_{105}/#7
5. DRY WT OF RETAINED MAT. + CRUCIBLE	97.7747	97.8718	101.8328	94.5222	104.8758
4. DRY ASH + CRUCIBLE	100.3144	11.1318	102.2245	95.7757	105.6410
3. DRY WT + CRUCIBLE	102.1566	100.4964	103.9704	95.2475	107.3493
2. WET WT.	196.78	173.42	175.62	199.13	197.08
1. TARE WT. OF CRUCIBLE	97.7357	96.5821	101.6250	93.2997	104.0100
(5-1) DRY WT OF RETAINED MAT.	.251	.5017	.2078	.2225	.8358
7 (2-1): NET WT OF SAMPLE	99.24	72.05	16.775	105.83	90.04
8 % DRY WT RETAINED MAT. [illegible]	.266%	.550%	.213%	.210%	.928%
9 % [illegible] RETAINED MAT. [illegible] ×100	10.6%	23.8%	8.57%	11.2%	25.2%
[illegible]	2.32%				

TEST	"SUSPENDED SOLIDS ANALYSIS"				
STREAM I.D.	SLUDGE P.S.	THICKENER K.S.	[illegible] K.S.	[illegible] THICKENERS	[illegible]
SYMBOL	S_{206}	S_{201}	S_{203}		
CRUCIBLE #	#5	#6	#3	#4	#X
4 DRY WT. + S.S.	53.1106	52.2757	51.6160	51.8239	50.4411
3-1 INITIAL WET WT.	36.00	28.0816	22.0076	27.1063	22.[illegible]
2 INITIAL WET WT.	52.3240	68.85	74.15	65.33	73.11
1. TARE WT.	[illegible].1118	52.0173	51.5216	51.4864	50.4217
5. (4-1) WT. OF SOLIDS	2.2088	.2584	.0564	.3375	.0176
6. (2-3) WT. OF SAMPLE	16.37	40.77	41.14	31.42	45.13
7 % S.SOLIDS 5/6 ×100	13.57%	.633%	.187	.901%	.0432

TEST	SIZE ANALYSIS [illegible] MESH SCREEN			% FINES .020" SCREEN			
STREAM I.D.	SCR. DIL. TANK	SEL P.S.	SEL K.S.	CLNFS P.S.	CLNFS K.S.	[illegible] P.S.	[illegible] K.S.
SYMBOL	S_{300}	S_{302}	S_{301}	S_{306}	S_{303}	S_{304}	S_{305}
CRUCIBLE #	#[illegible]	#50	#A	#C	#10	#B	#4
3. DRY WT OF RETAINED MAT. ON SCREEN + CRUCIBLE	91.8533	70.7350	.7334	85.8175	93.0764	96.3533	98.3161
2. WET WT OF SAMPLE	187.46	171.77	160.37	172.24	184.21	184.17	188.39
1. TARE WT.	90.5205	70.1477	64.1646	85.1362	91.4486	95.2883	98.2876
4. (3-1) WT OF RETAINED MAT. ON SCREEN	1.1328	.7873	1.1723	.6813	1.6278	1.065	.0285
5. (2-1) WT OF SAMPLE	96.94	101.62	94.21	87.20	91.86	88.90	90.25
6 % RETAINED [illegible] 4/5 ×100	1.17%	.777%	1.24%	.776%	1.77%	1.17%	.031%

% MAGNETICS		
STREAM ID.	[illegible]	NON-MAGNETICS
SYMBOL	—	—
CRUCIBLE #	A	A
3 WT. OF [illegible]	917.4	2253
2. WT. OF SAMPLE [illegible]	[illegible]	[illegible]
1. TARE WT.	107.4	107.4
4. (3-1) WT. OF MAG.	810	117.7
5 (2-1) WT. OF SAMPLE	833.4	245.8
6. [illegible] = 4/5 ×100	97.2%	13.74%

"T.G.M ANALYSIS"

TIME	0	10	20	30	40	50	60	70	80	90	100	110
DRY MAGNETICS + CRUCIBLE WT	175.7353	[illegible]	175.4000	175.1298	176.1307	[illegible]						
TARE WT.	78.2092	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—	—	—	—
(?-1) WT OF MAGNETICS												

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FRANKLIN SOLID WASTE REDUCTION PLANT EVALUATION - LAB SHEET

DATE Tue. 11th Mar. 74

STREAM I.D.	THICKENER REJ. STR.	PRESS R.S. STR.	CONES REJ. STR.	RUN DOWN SCREEN REJ.	CYCLONE R.S. OVERFLOW	SLUDGE	WHITE WATER	SELECTION PROC. STR.	CLEANERS PROC. STR.	SCREEN PROC. STR	RECOV. FIBER.	PROCESS WATER
SYMBOL	S_{301}	S_{203}	S_{303}	S_{305}				S_{302}	S_{306}	S_{308}	S_{316}	
CRUCIBLE #	37-Sm	42-Sm	43-Sm	-Sm	[illegible] Sm	45 Sm	41-Sm	38-Sm	-Sm	33-Sm	8-Mod	-Mod
4. DRY WT. (g)	23.1285	21.6154	24.4704		22.7637	25.6771	23.4038	24.1348		22.6433	101.2241	
3. WET WT. (g)	46.73	47.71	59.80		48.35	55.67	53.75	52.12		55.16	179.26	
1. TARE WT. (g)	22.8706	21.4777	27.7693		22.4594	24.1654	23.0764	23.5410		21.8268	98.3114	
2. VOLUME (ml)				OCC.			WEEKLY		OCC.			WEEKLY
5. SOLIDS WT. (g) (4-1)	.2579	.1377	?		.3043	1.5337	.3274	.5938		.8165	2.9127	
6. SAMPLE WT. (g) (3-1)	23.86	26.23	32.03		25.89	31.50	30.67	28.58		33.33	80.95	
7. $\frac{5}{2 or 6} \times 10^6$ = mg/l	10,800	5,250	?		11,500	48,700	10,700	20,800		24,500	36,000	
8. $\frac{5}{6} \times 10^2$ = % Solids	1.08	.525			1.19	4.87	1.07	2.08		2.45	3.60	
9. $\frac{5}{2 or 6} \times 8.344$ = lb/gal	–	–	–	–	–	–	–	–	–	–	–	–

STREAM ID	THICKENER PROC. STR	PRESS PROC. STR.	SURGE CHEST	REFUSE SLURRY	BREAKDOWN SOL. OIL TK	SELECTION REJ. STR.						
SYMBOL	S_{202}	S_{204}	S_{200}	S_{120}	S_{300}	S_{301}						
CRUCIBLE #	10-Mod	-Mod	15-Mod	18-Mod	-Mod	-Mod						
4. DRY WT. (g)	111.3480		104.1269	102.3725								
3. WET WT. (g)	115.05		187.30	193.22								
1. TARE WT. (g)	100.3015		101.4328	99.1165								
2. VOLUME (ml)		OCC.			OCC.	OCC.						
5. SOLIDS WT. (g) (4-1)	11.0465		2.6941	3.2560								
6. SAMPLE WT. (g) (3-1)	14.75		85.87	94.10								
7. $\frac{5}{2 or 6} \times 10^6$ = mg/l	[illegible]	[illegible]	31,400	34,600								
8. $\frac{5}{6} \times 10^2$ = % Solids	17.06		3.14	3.46								
9. $\frac{5}{2 or 6} \times 8.344$ = lb/gal	[illegible]	[illegible]	–	–	–	–	–	–	–	–	–	–

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Franklin Solid Waste Recovery Plant — Daily Data Sheet

Date: Tue 15th Feb. 72

HYDRASPOSAL and GLASS PLANT

		Time →	12:00					
HDRSPSL "A"	Cyclone P.W. Flow (pro scale = 90 gpm)		1201				— gpm	F600
							— %	S600
	Cyclone Proc. Str. (Sink to Splitter / inlet to pen)	Flow				90%	720 gpm	F120
		★					3.46 %	S120
	Cyclone Res. Overflow	[illegible]/gpm	1/115	/	/	/	115 gpm	F117
		★					1.15 %	S117
HDRSPSL "B"	Super Chest Proc. Str.	Flow	gpm	gpm	gpm	61 gpm	500 gpm	F200
		Level/°F	18 / [illegible]	/	/	/	3.14 %	S200
	Sludge Proc. Str.	Speed/Flow	19	/	/	/	19. gpm	F206
		★					4.87 %	S206
	Thickener Res. Str.	★					1.05 %	S201
	Proc. Str.	★					17.06 %	S202
	Press Res. Str.	[illegible]/[illegible]	6/10	/	/	/		
		gal/sec	3.2 / 1	/	/	/	.535 %	S203
	ft³/sec × 60 =	Flow	67.7 gpm	gpm	gpm	gpm	67.7 gpm	F203

Floor Residual conveyor [illegible]
+ 12x2x1.5 [illegible]
(21.8)+(33.6)+(36) = 91.4 x .13 = 11.9 Ton W106

Operating Times						
Pulper	11215? - [illegible]	x 60 =	425	min	T110
Sump Pump	7415.1 - [illegible]3	=	334	min	T
Refiner	1208.70 - [illegible]	x 60 =	355	min	T
Glass Plant		=	—	min	T150

Hydrasposal Wts. B/C			
Weighed Tons	3?.24	Ton	W
Gross Tons	3?.5	Ton	W
Tons Directly to Landfill (Wagon)	1.0	Ton	W
Mag. Separator - Magnetics	4.74	Ton	W
- Nonmagnetics	1.55	Ton	W
Cyclone Rejects	5.60	Ton	W
Trucks - Licensed	1	#	N
- Unlicensed	6	#	N
Standard For Vehicles	7	#	N

GLASS PLANT

Wet magnetics		Ton	W403
Oversize		Ton	W405
Wet nonmagnetics		Ton	W407
Dry magnetics		Ton	W411
Light (Al)		Ton	W413
Dust		Ton	W415
Ceramics stones		Ton	W417
Dry nonmagnetics		Ton	W419
Flint		Ton	W418
Amber		Ton	W422
Green		Ton	W420
Tramp [illegible]		Ton	W421

LC was on and off frequently

FIBRECLAIM and GENERAL PLANT

		Time →						
Process Water		★					.102 %	S690
White Water		[illegible]/flow	/	/	/	/	1.07 %	S590
Selectifier Feed		%/flow	15 /	4	4	4	gpm	F300
- Proc. Str.		★					2.08 %	S300
Cleaners P.W. Flow		[illegible]/flow	27 / 14.8	/	/	/	14.8 gpm	F020
- Res. Str.		sec/gpm	16 / 1.3					
		sec/gpm	4 / 15.9					
		sec/gpm	2.2 / 10.1					
		sec/gpm	6 / 13.9					
		sec/gpm	2 / 6.9				EST 5.0 %	S303
		sec/gpm	/					
		Tot. flow	48.1				48. gpm	F303
Screen Sprays (6 gpm each)		# /gpm	12 / 72	4	4	4	72. gpm	F621
- Prim Str. Bypass		20?/gpm	85 /				gpm	F810
- " " "		★					2.45 %	S302
Recovered Fiber		★					.360 %	S316

Operating Times							
Selectifier Feed	Tow 1782.59	1786.3	1787.4	1789.68	Tf - Ti × 60 =	425 min	T100
	Rise	1785.1	1786.9			132 min	T300
	Δ	+ 1.2	+ 1.0	+	See attached Sheet		
Cleaners Feed Pump	final 11725.2 - initial 11587.?				=	135 min	T304
Recovered Fiber Pump	0717.?3 - 0715.?0	= 2.13			× 60 =	128 min	T316

Water Meters						
Process Water	857155 - 85?524	= 6631	× 10	66,310 Gal	V650
White Water	[illegible] - 627137	= —	× 10	— Gal	V590
Ash Slurry	06877 - 00?07	=		3772 Gal	V210
City Water	0412765? - 0411?30	= 8300	× 7.479	62,080 Gal	V200

KWH Meters					
Total Plant	3183.6 - 3177.2	= 4.4	× 1800	7920 KWH
Fibreclaim	[illegible] - 4810.?	= —	× 640	— KWH
Glass Plant	0414.4 - 0412.9	= 1.5	× 100	150 KWH
Hydrapulper	04202 - 0415.0	= 5.2	× 320	1664 KWH

Clock value 2032?5 203202

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[illegible] SOLID WASTE REDUCTION PLANT - DAILY CALCULATIONS DATE [illegible]

HYDRASPOSAL "A"

[illegible] TONS RECEIVED + 33.5 TONS
[illegible]CYCLED [illegible] + 1.0 TONS
[illegible]SIDUAL - PREVIOUS + 47.2 TONS
" - CURRENT - 11.9 TONS
[illegible]PROCESSABLE JUNK - 1.0 TONS
PULPER INPUT (WET WT.) 73.8 TONS
PULPER INPUT (DRY WT.) - ___ TONS
[illegible] ___ % ___ TONS
[illegible] INPUT (DRY WT.) 46.0 DRY TONS
[illegible] (46.0) / (73.4) 16.7 TONS WATER
PULPER INPUT ([illegible]) = 12.7 TONS
[illegible] PULPED INPUT 58.2 TONS

JUNK REMOVER - MAGNETIC JUNK + 4.74 TONS
" " - NONMAGNETIC JUNK + 1.65 TONS
CYCLONE REJECT STREAM (GRIT) + 5.60 TONS
CYCLONE PROCESS STREAM (720)(425) × (3.46)(4.17×10⁻⁵) = + 306,000 GAL + 44.15 TONS
CYCLONE REJECTS OVERFLOW (115)(425) (1.18)(4.17×10⁻⁵) = + 48,900 GAL + 2.40 TONS
PROCESS WATER (200)(425) × (.102)(4.17×10⁻⁵) = - 85,000 GAL - .36 TONS
WHITE WATER: $V_{\text{CYCLONE P.S.}} - V_{\text{CYCLONE OVR.}} - V_{\text{PROC. WATER}}$ = 270,000 GAL
× (1.07)(4.17×10⁻⁵) - 12.04 TONS
PULPED INPUT ([illegible]) ([illegible]) 46.0 TONS

HYDRASPOSAL "B"

STOCK CHEST PROCESS STREAM (500)(355) × (3.14)(4.17×10⁻⁵) = 177,500 GAL 23.24 TONS
SLUDGE CHEST PROCESS STREAM (19.)(334) × (4.87)(4.17×10⁻⁵) = 6346 GAL 1.29 TONS
HYDRASPOSAL "B" INPUT 183,846 GAL 24.53 TONS
DEWATERING SECTION REJECTS - ___ GAL 7.49 TONS
REACTOR SECTION INPUT ___ GAL 17.04 TONS

THICKENER REJECT WR. = (177,500)(17.06 - 3.14) / (17.06 - 1.08)
= (177,500)(13.92) / (15.98) = 154,618 GAL
× (1.08)(4.17×10⁻⁵) 6.96 TONS
PRESS REJECT STREAM (67.7)(355) (.525)(4.17×10⁻⁵) = 24,033 .53
DEWATERING SECTION REJECTS 178,651 GAL 7.49 TONS

FIBER RECOVERY

1 FIBERCLAIM INPUT (BY SUMMATION OF [illegible]) 128,200 GAL 12.54 TONS
SELECTIFIER REJECT STREAM 37,100 GAL 4.64 TONS
[illegible] (135)(5)(135) + 91,100 GAL
× (2.68)(4.17×10⁻⁵) 7.90 TONS
AVERAGE FIBER RECOVERY INPUT 128,200 GAL 13.9 TONS
1 RUNDOWN SCREENS REJECTS 64,200 GAL 2.58 TONS
+ CLEANERS PROCESS STREAM + 94,400 GAL 6.59 TONS
+ SELECTIFIER PROCESS STREAM 91,100 GAL 7.90 TONS
+ [illegible] (5)(14.8)(132) × (.102)(4.17×10⁻⁵) 9,770 GAL .04 TONS
- CLEANERS REJECT STREAM 6,480 GAL 1.35 TONS
+ PROCESS WATER TO RUNDOWN SECTION SHOWERS (72.)(132) (.102)(4.17×10⁻⁵) 9,500 GAL .04 TONS
- RECOVERED FIBER - 23,700 GAL 3.55 TONS
(X,2)(92.5)(128) 23,700 GAL
(1,2)(425)(425) ___ GAL
(23,700)(3.60)(4.17×10⁻⁵) 23,700 GAL 3.55 TONS
(3.60) / (2.45) = 1.47
- DEWATERING REJECTS (23,700)(.677) = 16,000 GAL
(3.55)(.141) = .50 TONS

③ FIBERCLAIM INPUT (BY SUMMATION OF [illegible]) 128,200 GAL 15.19 TONS
[illegible] TO FIBERCLAIM (720)(132) (3.46)(4.17×10⁻⁵) + 95,000 GAL 13.71 TONS
WHITE WATER TO [illegible] (128,200) - (95,000) (1.07)(4.17×10⁻⁵) + 33,200 GAL 1.48 TONS

① SELECTIFIER REJECTS 37,100 GAL 4.64 TONS
+ REACTOR THICKENER INPUT 177,500 GAL 23.24 TONS
+ [illegible] CHEST (84 - 61)/(89 - 78)(720) × (3.14)(4.17×10⁻⁵) 7,930 GAL 1.04 TONS
- CLEANERS REJ. STR. (42.)(132) × (5.8)(4.17×10⁻⁵) 6,480 GAL 1.35 TONS
- [illegible] TO SLUDGE CHEST (720)(425 - 425) (3.46)(4.17×10⁻⁵) — GAL — TONS
- THICKENER CYCLONE REJ. STR. TO STOCK CHEST (720)(425 - 132)(.672) 141,800 GAL
(720)(425 - 132)(3.46)(352 × 10⁻⁶) 25.67 TONS

$R_V = V_{\text{DEWATERING REJECTS}} / V_{\text{RECOVERED FIBER (316)}}$
$R_W = W_{\text{DEWATERING REJECTS}} / W_{\text{RECOVERED FIBER (316)}}$
BOTH R_V + R_W ARE FROM CURVES INTERPRETING THE DEWATERING EFFICIENCIES OF THE THICKENER AND FIBER[illegible]

APPENDIX E

STREAMS DEFINITIONS

1. Hydrasposal "A"
2. Hydrasposal "B"
3. Fiber Recovery

Hydrasposal Sub-System A

Stream Definitions

Input - Total Refuse Wet Processed

Refuse Received. The total amount of refuse deposited on the tipping floor. This includes unprocessable refuse.

Refuse Weighed - All refuse received and passed over the scale.

Refuse Unweighed - All refuse received on a flat rate basis.

Tipping Floor Salable Junk Process Stream - Spring steel, white goods, etc.

Tipping Floor Unsalable Junk Process Stream - Tires, Bulky tree items, etc. (landfillable)

Tipping Floor Residual - Amount of refuse remaining on floor at end of operating day.

Net Tipping Floor Residual - This is equal to the Tipping Floor Residual initial - Tipping Floor Residual final.

Cyclone Process Stream - The process stream directed to the fiber recovery system from the cyclone.

Cyclone Rejects Stream (Grit) - That portion of the hydrapulper slurry process stream removed by the cyclones.

Hydrapulper Junk Process Stream - That portion of the tipping floor conveyor process stream removed by the junk remover in the hydrapulper.

Hydrasposal Magnetic Rejects - The magnetic portion of the solids in the hydrapulper junk process stream.

Hydrasposal Non-Magnetic Rejects - The non-magnetic portion of the solids in the hydrapulper junk process stream.

Hydrasposal Sub-System B

Stream Definitions

Waste Slurry Stream - Total stream directed for disposal by Incineration. (Surge chest process stream).

a) When Fiber Recovery System is operaating, this stream consists of the rejects tank process stream.

b) When Fiber Recovery System is not operation, this stream consist of the cyclone process stream.

Sewage Sludge - Sewage sludge directed to the cone press from the wastewater plant.

Thickener Process Stream - Thickened output stream.

Thickener Reject Stream - Liquid expelled from the waste slurry stream by the thickener.

Cone Press Process Stream - Cone press output stream.

Cone Press Reject Stream - Liquid expelled from the thickener process stream by the cone press.

Scrubber Rejects Stream - The waste stream issuing from the scrubber (Ash Slurry).

Scrubber Venturi City Water - Input to the Venturi scrubber (City Water).

Fiber Recovery System

Stream Definitions

Cyclone Process Stream - The process stream directed to the Fiber Recovery System from the Hydrasposal Sub-system A.

Selectifier Process Stream - That portion of the selectifier dilution tank process stream that is not removed by the selectifier screen.

Selectifier Rejects Stream - That portion of the selectifier dilution tank process stream that is removed by the selectifier screen.

Centrifugal Cleaner Process Stream - That protion of the selectifier process stream that is not removed by the centrifugal cleaners.

Centrifugal Cleaner Rejects Stream - That portion of the selectifier process stream removed by the centrifugal cleaners.

Reject Tank Process Stream - The combined selectifier rejects and centrifugal cleaner reject stream. (At times this may also include the run down screen process stream).

Run Down Screen Process Stream - That portion of the centrifugal cleaner process stream which is not removed by the run down screen.

Run Down Screen Rejects Stream - The portion of the centrifugal cleaner process stream removed by the run down screen.

Barrel Thickener Process Stream - The barrel thickener output stream.

Barrel Thickener Reject Stream - The liquid portion of the run down screen process stream which is removed by the barrel thickener.

Cone Press Process Stream - The cone press output stream.

Cone Press Reject Stream - The liquid portion of the barrel thickener process stream that is removed by the cone press.

TABLE

JUNK REMOVER MAGNETIC AND NON MAGNETIC REJECTS

MAGNETIC REJECTS DATA

Category	Sample 1		Sample 2		Average
	Pounds	Percent	Pounds	Percent	Percent
Tin Cans	75.6	62.6	80	67.5	65.0
Bottle & Jar Caps	4.1	3.4	1.0	.84	2.1
Metal Ends from Paper/Metal Cans	0.5	0.4	0.5	.42	0.4
Misc. Ferrous Metal	23.0	19.0	23	19.4	19.2
Metal Cans with Aluminum Tops	14.2	11.8	13	10.9	11.4
Contaminants (wood, plastic, etc.)	3.4	2.8	0.5	.42	1.6
Non Magnetic Metals	----	----	0.5	.42	0.2
TOTALS	120.8	100	118.5	99.9	99.9

NON MAGNETIC REJECTS DATA

Category	Sample 1		Sample 2		Average
	Pounds	Percent	Pounds	Percent	Percent
Aluminum	26.7	15.2	11.7	12.7	14.3
Organics	33.8	19.2	14.1	15.3	17.9
Total Ferrous	25.5	14.5	15.0	16.3	15.1
Magnetic Ferrous	(21.0)	(11.9)	(9.5)	(10.3)	(11.4)
Rocks, Inert, Glass	79.3	45.2	44.8	48.6	46.4
Rocks	(41.3)	(23.5)	(16.4)	(17.8)	(21.6)
Glass	(38.0)	(21.6)	(28.4)	(30.8)	(24.8)
Copper/Brass	10.2	5.8	6.5	7.1	6.2
TOTALS	175.5	99.9	92.1	100	99.9

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WATER CONSUMPTION

ALL VALUES IN GALLONS

Week	Process H_2O TOTAL	Process H_2O-Fib. Rec.	White H_2O TOTAL	White H_2O Hydra A	White H_2O Fiber Rec.	Process Water Hydra A
7 Jan	241,900	-------	810,000	810,000	-----	
14 Jan	248,300	-------	828,000	828,000	-----	164,350
21 Jan	308,000	70,030	563,000	514,000	49,000	188,100
28 Jan	556,000	180,000	1,289,000	1,127,000	162,000	351,500
4 Feb	414,000	134,000	837,000	831,000	6,000	266,000
11 Feb	353,000	212,000	827,000	827,000	-----	285,950
18 Feb	436,000	176,000	848,000	802,000	46,000	284,050
25 Feb	371,400	117,000	712,000	707,000	5,300	253,650
4 Mar	531,000	221,000	1,058,000	962,000	96,200	336,300
11 Mar	512,000	188,000	1,224,000	1,134,000	89,600	371,450
18 Mar	299,000	59,000	652,000	612,000	39,300	220,400
25 Mar	318,000	72,800	867,000	640,000	227,000	123,500
1 Apr	261,000	35,200	683,000	603,000	80,000	200,450
8 Apr	255,000	51,600	631,000	563,000	67,600	177,650
15 Apr	434,000	111,000	1,147,000	1,013,000	134,000	313,500
22 Apr	352,000	85,200	820,000	740,000	79,600	253,650
29 Apr	386,000	59,300	942,000	889,000	52,600	236,550
6 May	378,000	59,400	878,000	637,000	241,000	286,900
13 May	435,000	122,000	970,000	807,000	163,000	270,750
20 May	548,000	152,000	1,262.000	1,043,000	219,000	339,150
27 May	439,000	141,500	1,165,000	994,000	221,000	288,800
3 June	521,000	222,000	1,115,000	1,019,000	96,000	351,500
10 June	401,000	161,400	852,000	711,000	141,000	253,650
TOTAL	8,508,000	2,630.000	20,980,000	18,760,000	2,215,000	5,817,800
Max.	556,000	222,000	1,289,000	1,134,000	241,000	371,450
Min.	241,900	35,200	563,000	514,000	5,300	123,500
Avg.	405,100	125,000	926,000	815,000	111,000	264,445
N	21	21	20	20	20	22

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POWER AND WATER CONSUMPTION DATA/TON REFUSE INPUT

	HYDRASPOSAL "A"			FIBRE RECOVERY			HYDRA "B"
	*Average weekly values			**Average weekly values			Average weekly values
Week	gal w.w. Ton	gal p.w. Ton	Kwh Ton	gal w.w. Ton	gal p.w. Ton	Kwh Ton	gal c.w. Ton
7 Jan	5243	1476	33.5	---	---	---	---
14 Jan	6320	1320	27.0	---	---	---	---
21 Jan	4638	1790	33.7	914	1305	27.0	---
28 Jan	5000	1642	32.9	---	1260	23.3	---
4 Feb	5690	1910	39.9	107	2370	24.7	---
11 Feb	5310	1930	40.3	---	1490	19.9	---
18 Feb	5270	1960	36.0	475	1810	22.6	---
25 Feb	4840	1830	31.1	102	2250	23.2	---
4 Mar	5190	1910	38.7	806	1850	27.8	3100
11 Mar	7840	2703	46.4	826	1730	28.1	3650
18 Mar	4510	1706	31.6	1040	1569	24.3	3070
25 Mar	4870	989	25.3	3840	1233	19.2	3960
1 Apr	3960	1380	27.2	2530	1113	19.0	2580
8 Apr	4330	1440	30.7	1860	1420	24.0	2690
15 Apr	5550	1590	31.4	2050	1700	17.6	2340
22 Apr	4380	1600	36.0	1420	1520	22.6	1890
29 Apr	3860	1080	27.8	1560	1760	21.1	1800
6 May	2680	1270	22.8	4720	1162	20.7	1460
13 May	3770	1330	27.5	1690	1260	19.8	2300
20 May	4600	1570	29.0	2350	1630	23.6	2480
27 May	5590	1800	33.1	---	1730	24.7	2490
3 June	5300	1930	34.5	906	2096	12.1	2340
10 June	3760	1410	30.4	1240	1420	15.2	2200
TOTAL	112,501	37,566	746.8	28,436	33,678	460.5	38,350
Max.	7840	2703	46.4	4720	2370	28.1	3690
Min.	2680	989	22.8	102	1113	12.1	1460
Aver.	4891	1633	32.5	1580	1604	21.9	2557
N	23	23	23	18	21	21	15

*Tons are pulper inpur wet weight

**Tons are dry weight input

WW- Whitewater
PW- Process Water
CW- City Water

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TEST PROCEDURES FOR ANALYSIS OF INPUT REFUSE

The analysis of the input refuse involves the separation of the refuse into various categories which can be used to characterize the refuse. Most of the past analyses of municipal solid waste were made to determine design criteria for incinerators, sanitary landfills, or composting projects. Each of these disposal methods requires different information, so different separation categories were used for each system. Criteria important to incineration design are calorific value, moisture content, noncombustible content and components whose combustion products are corrosive. A typical classification system may include the following categories:

A. Combustible
   - Food Waste
   - Garden waste
   - Paper products
   - Plastic, leather, rubber
   - Textiles
   - Wood Limbs, sawdust

B. Noncombustible
   - Ferrous
   - Non-ferrous
   - Glass
   - Ceramics
   - Ash, earth, rocks

Criteria important to sanitary landfill design and operation include the amount of decomposable organic matter and density of the compacted refuse. Components affecting the composting of refuse include noncompostable materials, moisture and chemical composition.

There are several classification systems that could be used

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to classify the refuse received at the Franklin Plant. These classification systems are given in the following tables.

Categories Specified by the National Survey of Community Solid Waste Practices

1. General Paper wastes
2. Metallics, ferrous, nonferrous
3. Food
4. Yard
5. Wood
6. Glass
7. Plastic, rubber
8. Miscellaneous

Categories Specified by the Bureau of Solid Waste Management

1. Food wastes
2. Garden wastes
3. Paper products
4. Plastics, rubber and leather
5. Testiles
6. Wood
7. Metal products
8. Glass and ceramic products
9. Ash, rocks, and dirt

Categories Specified in "Municipal Refuse Disposal"[1]

1. Cans
2. Bottles
3. Ferrous metals
4. Nonferrous metals
5. Rags
6. Paper
7. Plastic, leather, rubber
8. Wood, limbs, sawdust
9. Food wastes, grass clippings, leaves
10. Bricks, stones, dirt, ashes

Categories used by Black Clawson Company on Whole Refuse

1. Glass
2. Paper
3. Ferrous metals
4. Vegetation
5. Wood
6. Rags
7. Plastics, rubber
8. Unclassified amount

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[1] Municipal Refuse Disposal, Institute for Solid Wastes of American Public Works Assn, Interstate Printers and Publ, 1970

The classification system for the whole refuse received at the Franklin facility should be directed toward the recoverable materials in the refuse and produce results which will be comparable to those achieved by other classification systems.

Most of the above classification systems do not adequately characterize the refuse for the Franklin Plant, therefore the following classification system is proposed to better fit the objectives of the Franklin Solid Waste Study.

Proposed Classification System for Input Refuse

1. Glass
2. Paper
3. Metals (magnetic and nonmagnetic)
4. Nonfiber organic materials
   (wood, food and garden, textiles, plastics)
5. Inert materials
   (dirt, rocks, ashes, ceramics)

The aluminum content of the refuse can be determined from the aluminum fractions of the cyclone rejects and nonmagnetic junk.

The composition of the input refuse will be determined by hand sorting samples into the above categories. Pieces of refuse composed of materials from more than one category which cannot be easily separated will be placed in the category representing the largest portion of the piece. For example, a metal toy with plastic wheels consisting largely of magnetic metal would be placed in that category.

Relatively large samples are required of municipal solid waste because of the extreme heterogenity and particle size range. Municipal Refuse Disposal[1] suggests that a minimum sample size of 500 pounds be used as an initial sample. However, more recent studies on solid waste sampling procedures by the Bureau of Solid Waste Management[2] have indicated that a 200 pound sample is adequate. At this time, Systech proposes to use 200 pound samples.

The number of samples required to characterize the input refuse is based on the precision and confidence level desired. If the percentage of a component of solid waste is to have a given probability of being within a specified range the number of samples required to obtain this degree of confidence can be determined by calculation using the following formula:[2]

$$m = \left[\frac{(z\ s)}{\delta}\right]^2$$

where z = normal standard deviate for the confidence interval desired

s = estimated standard deviation (determined experimentally to be 0.1632)

m = number of samples required

δ = sensitivity defined as

$2 \arcsin \sqrt{x - 2} \quad \arcsin \sqrt{x \pm \Delta}$ where x is the average percentage and Δ is the precision required.

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[2] Reference: Sample Weights in Solid Waste Composition Studies Albert J. Klee and Dennis Corruth; Journal of Sanitary Engr. Div. ASCE Vol 96, No. SA4, Aug 1970.

The preceeding formula was used for determining the number of samples required to obtain the percentage of a refuse component with a 90% probability of being within a ± 5% range.

The estimated values of refuse components used for calculation of the number of samples required are based on tests made on the Franklin refuse by the Black Clawson Company. The estimated composition of the Franklin solid waste is given as follows:

	Percent Wet Weight
1) Glass	10%
2) Paper	35%
3) Magnetics	10%
4) Non fiber organic materials	40%
5) Inert materials	5%
	100%

The number of samples required for a 90% probability of being within 5% of the correct value of the refuse component is calculated as follows:

Number of samples required for glass component $= \left[\frac{(1.645) \quad (0.1632)}{(\quad .6435 - \quad .7954)}\right]^2 = 3.12$

Number of samples required for paper component $= \left[\frac{(1.645) \quad (0.1632)}{(\quad 1.2661 - 1.3694)}\right]^2 = 6.75$

Number of samples required for magnetic component $= \left[\frac{(1.645) \quad (0.1632)}{(\quad 0.6435 - \quad .07954)}\right]^2 = 3.12$

Number of samples required for non fiber organic component $= \left[\frac{(1.645) \quad (0.1632)}{(\quad 1.0472 - 1.1593)}\right]^2 = 7.04$

$$\text{Number of samples required for inert component} = \left[\frac{(1.645)\quad(0.1632)}{(0.4510 - 0.6435)}\right]^2 = 1.94$$

Seven samples are required to establish 90 percent confidence in a 5 percent variation for all of the above categories. The moisture content of the individual can be determined by analysis of representative samples.

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